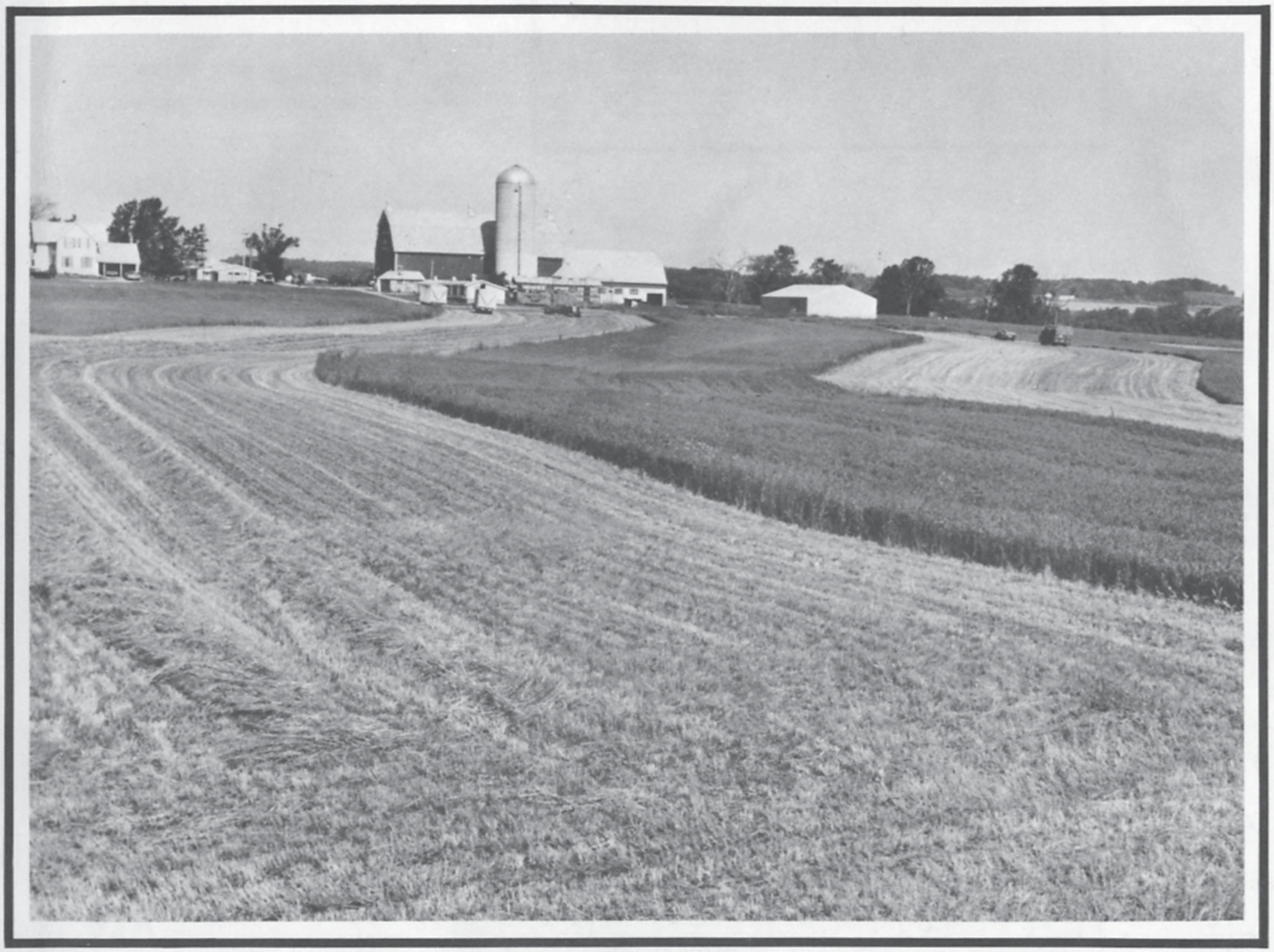
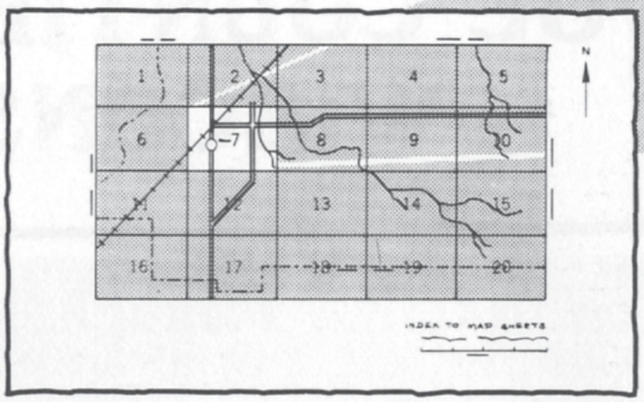
SOIL SURVEY OF
CALUMET AND MANITOWOC COUNTIES, WISCONSIN

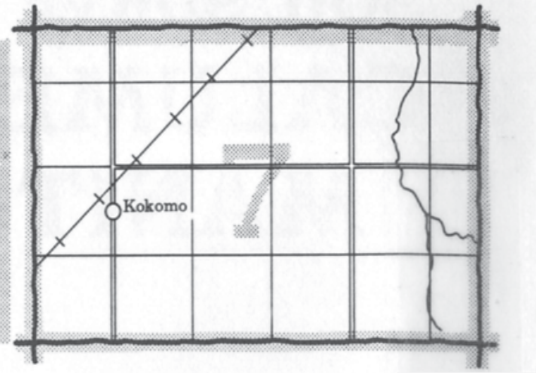


United States Department of Agriculture
Soil Conservation Service
in cooperation with
Research Division of the
College of Agricultural and Life Sciences
University of Wisconsin

HOW TO USE

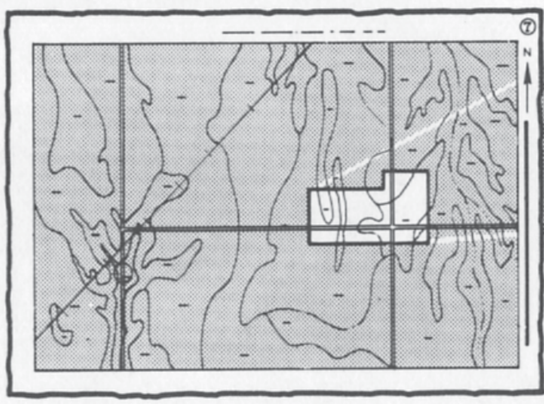
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

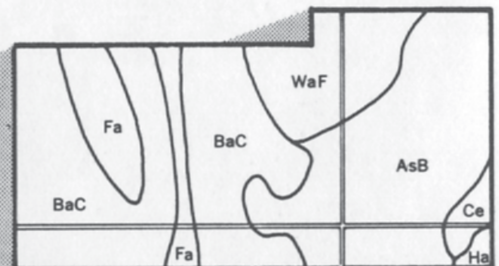




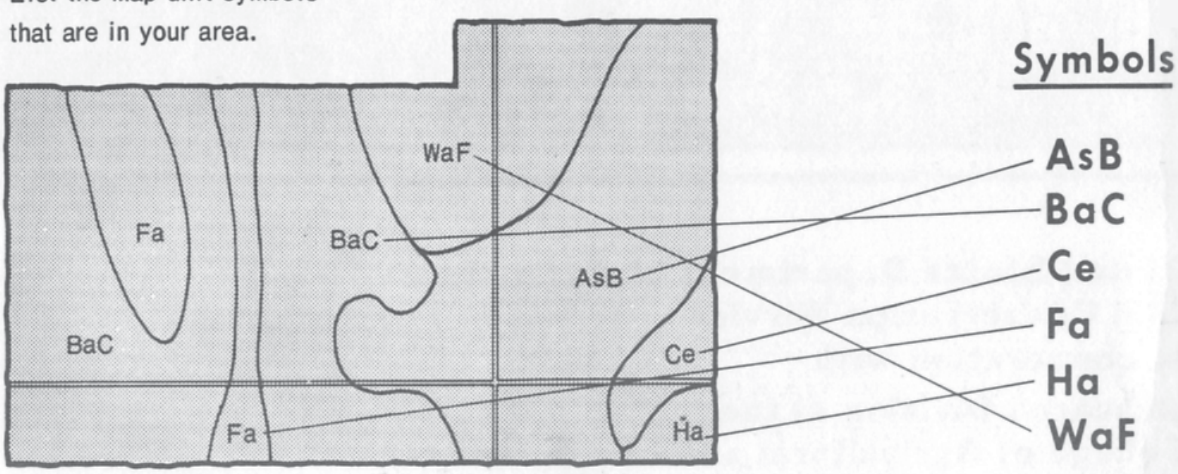
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



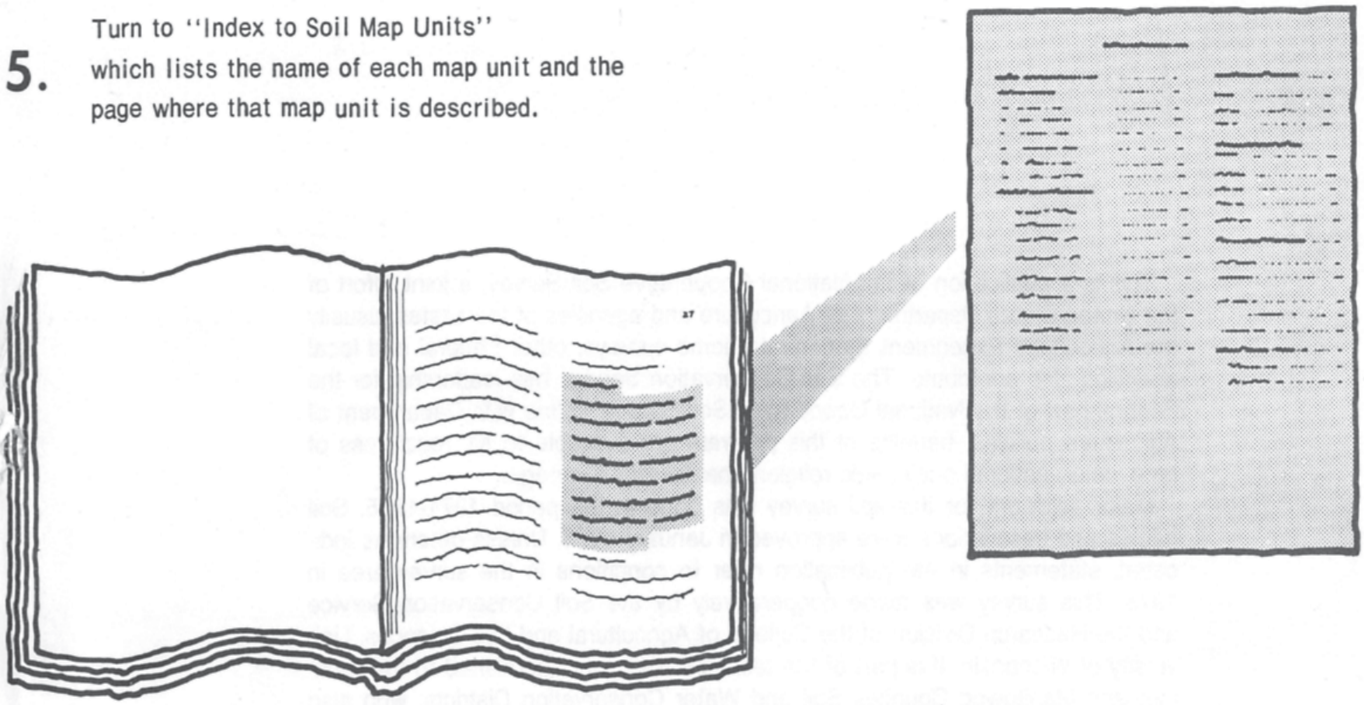


4. List the map unit symbols that are in your area.

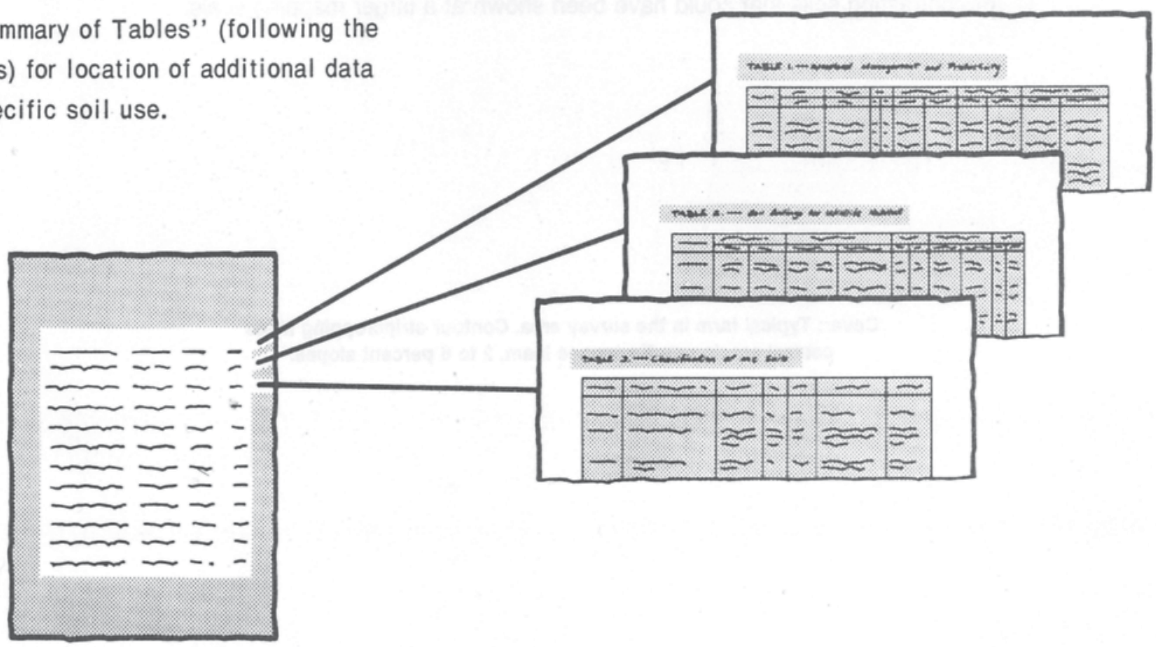


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was done in the period 1971-1975. Soil names and descriptions were approved in January 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Calumet and Manitowoc Counties Soil and Water Conservation Districts, who also helped finance the fieldwork for this soil survey.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Typical farm in the survey area. Contour stripcropping helps control erosion on Kewaunee loam, 2 to 6 percent slopes.

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Issued February 1980

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Summary of tables

Foreword

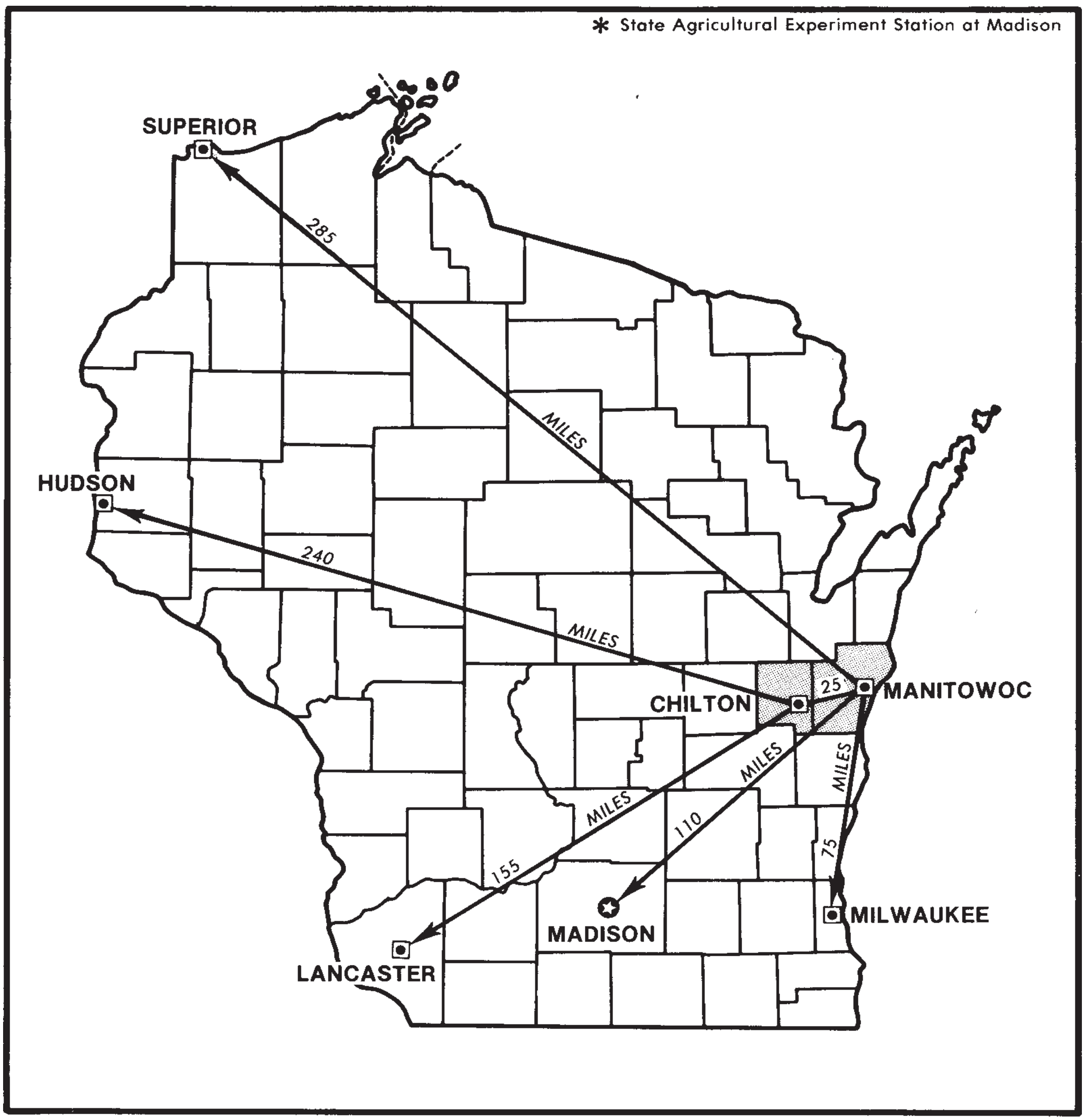
This soil survey contains much information that can be used in land-planning programs in Calumet and Manitowoc Counties. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Jerome C. Hytry
State Conservationist
Soil Conservation Service



Location of Calumet and Manitowoc Counties in Wisconsin.

soil survey of

Calumet and Manitowoc Counties Wisconsin

By Augustine J. Otter, Soil Conservation Service

Soils surveyed by Burel S. Butman, John E. Campbell, Kim A. Kidney, Everett J. Kissinger, Charles F. Leonard, Ernest G. Link, Kenneth W. Lubick, Larry L. Natzke, Augustine J. Otter, Robert A. Patzer, and Marvin C. Suhr, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service in cooperation with the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin

CALUMET and MANITOWOC COUNTIES are in the eastern part of Wisconsin. Calumet County is bordered on the west by Lake Winnebago and on the east by Manitowoc County. At its widest points, Calumet County is about 18 miles east to west and 24 miles north to south. The total area is about 251,520 acres, or 393 square miles. Of this total, about 45,184 acres is areas of water. The population of Calumet County was 27,604 in 1970. Chilton, in the central part of the county, is the county seat.

Manitowoc County is bordered on the east by Lake Michigan and on the west by Calumet and Brown Counties. At its widest points, Manitowoc County is about 26 miles east to west and 30 miles north to south. The total area is about 378,240 acres, or 591 square miles. Of this total, about 896 acres is areas of water. The population of Manitowoc County was 82,294 in 1970. Manitowoc, in the eastern part of the county, is the county seat.

About 85 percent of the land area is in farms. The main type of farming is dairying. The main crops are corn, oats, and alfalfa.

This survey area is in the Southeastern Wisconsin Drift Plain Land Resource Area. The soils are dominantly light colored clayey and loamy soils that formed under forest vegetation. Slope is the main management concern in cultivating the soils in the survey area. Soils that have slopes of more than 2 percent are subject to water erosion if they are not protected. The nearly level soils are mostly seasonally wet and need drainage.

General nature of the survey area

Norman E. Schmeichel and Bruno A. Zucollo, district conservationists, Soil Conservation Service, helped prepare this section.

This section discusses climate, settlement and development, transportation and industry, natural resources, and farming in the survey area.

Climate

Calumet and Manitowoc Counties are on the northern edge of the Corn Belt. Most areas of these counties are in dairy farms, and some acreage is in vegetable crops grown for processing. Except for field corn, most of the crops grown are cool-weather crops.

The climate of Calumet and Manitowoc Counties is continental, characterized by marked changes in weather common to the latitude and the interiors of large land areas. A small, narrow belt adjacent to Lake Michigan has a modified continental climate. Lake Michigan's influence is strongest in spring, summer, and fall.

There is a tendency for extremes in the climate. Spring is often slow in arriving and is a mixture of warm and cold periods. As summer approaches, precipitation is less frequent but increases in intensity. Several hot and humid periods in summer last only a few days. Cool periods can occur in any month in summer. Dew, which is often heavy, forms in most mornings. Fall arrives suddenly early in October and often lingers into November. In nearly every year, after the first killing freeze, there are periods of days that are abnormally warm and that have generally clear and sunny skies and cool nights. The change from fall to winter is often abrupt.

The average date of the last 32 degree freeze in spring is May 17, and the first freeze in fall is October 2. The growing season, which is the number of days between the last 32 degree freeze in spring and the first in fall, averages 138 days. It varies slightly within the county, depending on nearness to water and location, that is, in a valley or on a hilltop or slope.

Precipitation generally is adequate for agricultural purposes, although in July and August there is some deficiency in soil moisture. Severe drought affecting crops is rare. Most of the precipitation in summer falls in the form of showers that tend to vary greatly in intensity.

Dry days are important in curing hay in the field; a dry day is one in which less than 0.1 inch of rain falls. The number of dry days averages 22 in June and 25 each in July and August.

Hail falls on about 2 days a year, but in extreme years it falls on about 5 to 10 days.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Chilton for the period 1930 to 1959. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring.

In winter the average temperature is 20 degrees F, and the average daily minimum temperature is 11.8 degrees. The lowest temperature on record, which occurred at Chilton in January 1951, is -33 degrees. In summer the average temperature is 68.8 degrees, and the average daily maximum temperature is 80.9 degrees.

Of the total annual precipitation, 19.12 inches, or 65.4 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 9 inches. The heaviest 1-day rainfall during the period of record was 6.39 inches at Manitowoc on July 23, 1920. There are thunderstorms each year, and most occur in June and July.

Average seasonal snowfall is 43.8 inches. The maximum monthly snowfall during the period of record was 29.5 inches. The average date when there is 1 inch or more of snowfall in 1 day is November 21. The chance of this amount of snowfall by October 21 is 1 in 10 years and by December 22, 9 in 10 years.

The percentage of possible sunshine is 60 in summer and 40 in winter. The prevailing wind is from the west, northwest, and southwest. Average windspeed is highest, 13 miles per hour, in April and November.

Settlement and development

The land now included in Calumet County was probably first visited in 1634 by Jean Nicolet, a French explorer (*4*). The county was formed from a part of Brown County in 1836 and named after an Indian village on the shore of Lake Winnebago. The county was organized in 1843, and its present boundaries were established in 1848.

Father Marquette and Louis Joliet first skirted Manitowoc County along the shore of Lake Michigan in 1673. It was established as a county in 1836, and its present boundaries were established in 1850.

The first settlement in the survey area was concerned with harvesting timber, which was abundant. Water power was developed to saw the logs. Logs were shaped into boards and shingles and transported by water to Milwaukee, Chicago, and more distant markets. Fishing enterprises were established around Lake Michigan to take advantage of the abundance of whitefish in the lake. During this period, the city of Manitowoc grew as an important lake port.

As the timber was removed, wheat farming became the main enterprise. About 1870, wheat farming gave way to diversified farming. Eventually dairy farming became the main farming enterprise.

Both counties were at one time inhabited by Indians. In the early years, immigration into the counties was light. In the first census, taken in 1850, a total of 1,743 people lived in Calumet County and 3,702 in Manitowoc County. The population of the survey area increased rapidly between 1850 and 1860. It continued to increase but at a slower rate until about 1950. The census of 1970 showed that both counties were decreasing in population.

Transportation and industry

The first means of transportation was by boat because of the many watercourses throughout the survey area. In about 1840 the first county road was surveyed, and in 1872 the first railroad was established. Since this time many miles of roads have been built, and only a few places are more than one-half mile from the nearest road.

Calumet County has a well developed highway system consisting of two U.S. highways and four state highways. Manitowoc County has three U.S. highways and eight state highways. There is either a county or a town road on nearly every section line within the survey area. The survey area is also served by more than a dozen truck lines that haul freight. Commercial bus service is available throughout.

Calumet and Manitowoc Counties are served by three railroads. Commercial airline service and aircraft charter service are available at the Manitowoc Municipal Airport.

The port of Manitowoc handles more than two million short tons of cargo each year. Through the St. Lawrence Seaway this port can ship cargo to any port in the world.

Calumet County has seen a rapid expansion of manufacturing industries during the past several decades. The county remains mainly agricultural, but manufacturing employs more people than does farming. In 1970, there were 4,303 people employed in manufacturing and 1,496 people employed as farmers and farm laborers (*12*). Many people are employed in the metalworking and machinery industries.

Manitowoc County has attained a high degree of urban-industrial development. In 1970, there were 13,621 people employed in manufacturing and 2,318 people employed as farmers and farm laborers (*13*). The county has diversified manufacturing. It is well known for its aluminum goods and, particularly during World War II, for shipbuilding. Other industries produce aluminum products, heavy construction machinery, electrical equipment, food, furniture, paper products, and mineral products.

Natural resources

Soil and water are the two most important natural resources in the survey area.

Much of the topography of the survey area is controlled by the underlying bedrock. The Niagara escarpment, which is a part of the Niagara dolomite formation, parallels the east shore of Lake Winnebago. The survey area is in the Eastern Ridges and Lowlands geographical province of Wisconsin (*6*). The highest point in the survey area is in the town of Stockbridge, Calumet County, where the elevation is 1,128 feet above sea level. The lowest point is the surface of Lake Michigan, which is 580 feet above sea level.

The soils in the survey area formed mostly in glacial drift of Wisconsin Age. They are mostly nearly level and gently sloping and are medium in natural fertility. The various advances of the glacial ice masses deposited different types of till in which many of the soils developed.

Valders till, which was deposited by the last major glacial advance, is common in the survey area. It occurs in about two-thirds of Calumet County and in one-half of Manitowoc County. Valders till is easily recognized by its red color and clayey texture. Kewaunee and Manawa soils formed in Valders till.

Cary till was deposited by an earlier ice advance. In many areas it underlies Valders till. Two lobes of Cary till were deposited in the survey area. One of the lobes is in the southwestern corner of Manitowoc County and extends into the southern part of Calumet County. This lobe of Cary till is easily distinguished from the Valders and the other Cary lobe by its yellowish color, loam or sandy loam texture, and high content of calcium carbonate. The major soils in this lobe of Cary till are Hochheim, Lamartine, and Theresa soils.

The other lobe of Cary till is in the northwestern part of Manitowoc County. It is reddish in color, has a lower content of calcium carbonate, and is sandy loam, loam, or clay loam. The major soils in this lobe of Cary till are Hortonville, Symco, and Waymor soils.

The thickness of the glacial drift ranges from a trace to more than 150 feet throughout the survey area. The major soils that formed in a trace of drift over dolomite bedrock are Channahon, Kolberg, and Whalan soils. The dolomite is used for construction purposes and agricultural lime.

Melt water from the receding ice masses deposited sand and gravel as river terraces, eskers, kames, and outwash plains. Boyer and Lutzke soils are the major soils underlain by sand and gravel. The sand and gravel is used for road construction.

Most of the early settlements were along rivers and lakes. Early settlers used water as a source of power to cut lumber. Water also served as a means of transportation and provided fish for food. The survey area has an excellent supply of underground water. Potable water is available in almost every part of the survey area, although it is sometimes necessary to drill to 200 feet or more to tap an adequate supply.

The main aquifer is the Niagara Dolomite formation. This aquifer begins at the Niagara escarpment adjacent to Lake Winnebago and continues eastward to Lake Michigan.

The general flow of surface water is toward Lake Michigan. Surface water includes about 34 miles of Lake Michigan shoreline, 22 miles of Lake Winnebago shoreline, eight rivers, and many streams and lakes. The survey area has more than 30 small to medium-sized lakes. Many areas are subject to flooding or ponding during periods of peak runoff.

Farming

Except for small clearings used to grow food crops for home use, there was very little farming in the survey area until about 1850. Between 1850 and 1870, wheat was the main crop. After 1870, dairy farms began to increase in number and are now the most prominent in the survey area. Cash crop farming is also important. The common dairy farm crops are corn, oats, and alfalfa.

The common cash crops are wheat and vegetables, including peas, sweet corn, potatoes, beans, beets, and carrots.

In 1969, 89 percent of the land in Calumet County and 80 percent of the land in Manitowoc County were in farms. Hay, mainly alfalfa, is the major crop; 152,139 acres were harvested in 1969. Small grain is the second largest crop; 87,959 acres were harvested in 1969. Corn was the third largest crop; 60,964 acres were harvested in 1969. Only about 39 percent of the corn acreage is harvested for grain; the remainder is used largely for corn silage.

The number of farms in the survey area is decreasing, and the average size is increasing. In 1964, there were 4,103 farms in the survey area with an average size of 123 acres. In 1969, there were 3,612 farms with an average size of 135 acres.

Each year more cropland is being used as sites for houses and for recreation and other nonfarm uses. In spite of this decrease in land used for farming, production in the county has increased.

Only about 7 percent of the labor force in Calumet County and 9 percent in Manitowoc County are farmers or farm laborers. Agricultural gross sales are slightly higher than sales of manufactured products; thus, farming is the main enterprise in the survey area.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After classifying and naming the soils, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil. Map units are described under "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their characteristics may be modified during the course of the survey. New interpretations are made for local use, mainly through field observations of different soils in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same soils.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is usable to farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land-use planning

The general soil map at the back of this publication shows map units that have a distinct pattern of soils, relief, and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscape in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The map units in this survey have been grouped into 6 general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included map units are described on the following pages.

Map units on the general soil map do not fully agree with those on the general soil map for adjacent counties published at a different date. Differences in the maps are the result of improvement in the classification of soils, particularly in the modification or refinement in soil series concepts. More precise and detailed maps are needed because the uses of the general soil maps have expanded in recent years; the more modern maps meet this need. Another difference in maps is the pattern of occurrence of the major soils or the range in slope that is permitted within map units in different surveys.

Areas dominated by soils that formed in glacial till

This group of map units makes up about 64 percent of the survey area. The soils are nearly level to moderately steep. They have a loamy surface layer and a loamy or clayey subsoil and substratum. They are well drained to poorly drained and are moderately permeable to slowly permeable.

Most of the soils are in cropland. Corn, small grains, and hay are the main crops. Some of the steeper soils and undrained wet soils are used for pasture, as woodland, or as wildlife habitat.

The soils in this group have fair to poor potential for use as septic tank absorption fields. Wetness, slope, and permeability are the main limitations.

1. Kewaunee-Manawa-Poygan

Nearly level to sloping, well drained to poorly drained soils that have a dominantly clayey subsoil and substratum

This map unit consists of soils on undulating ground moraines made up of knolls, ridges, and plains that are dissected by drainageways and broad depressions. The soils are mostly nearly level to sloping, but along the sides of drainageways and on escarpments they are steeper.

This map unit makes up about 44 percent of the survey area. It consists of about 50 percent Kewaunee soils, 25 percent Manawa soils, 5 percent Poygan soils, and 20 percent minor soils (fig. 1).

Kewaunee soils are on convex knolls and ridges on glacial till uplands. They are gently sloping and sloping and are well drained. Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay.

Manawa soils are on concave side slopes and in drainageways and depressions on till plains and in lacustrine basins. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer

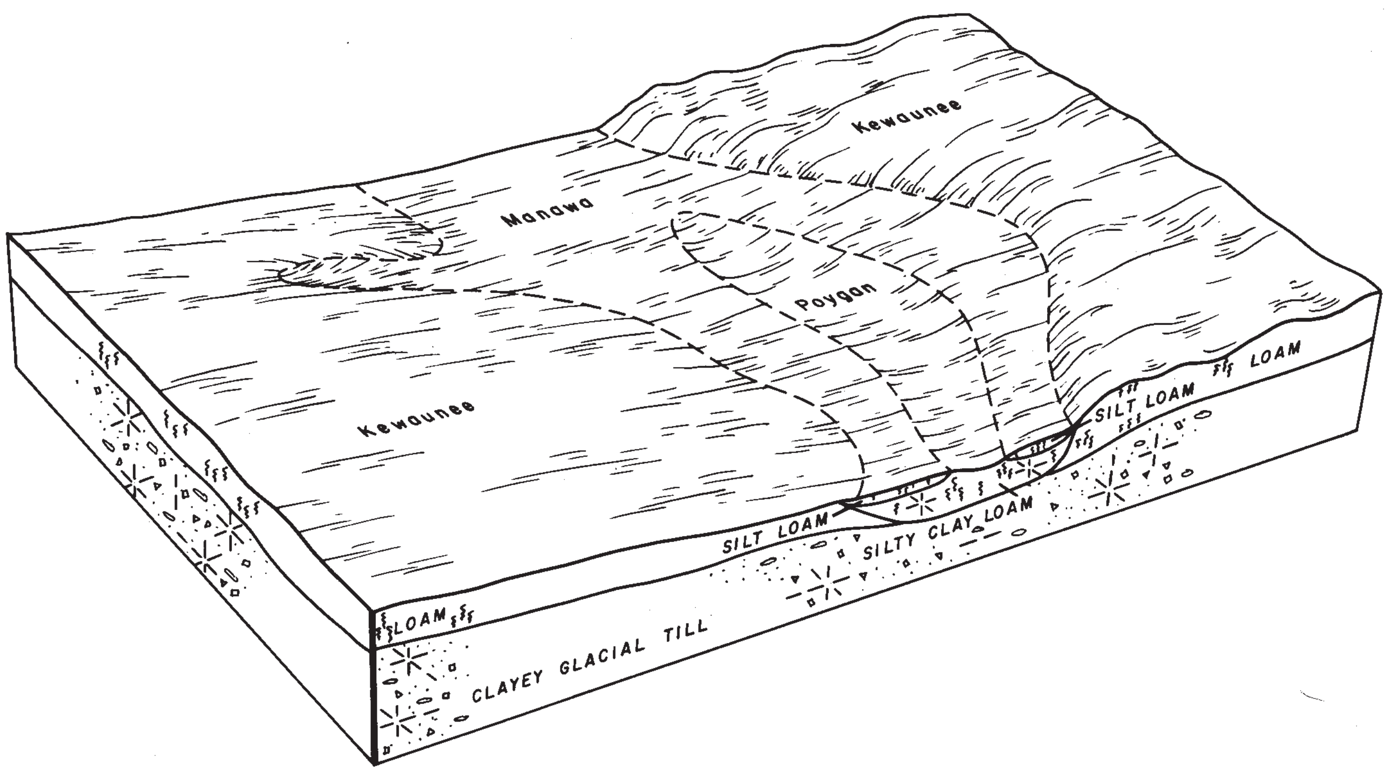


Figure 1.—Typical pattern of soils in the Kewaunee-Manawa-Poygan map unit.

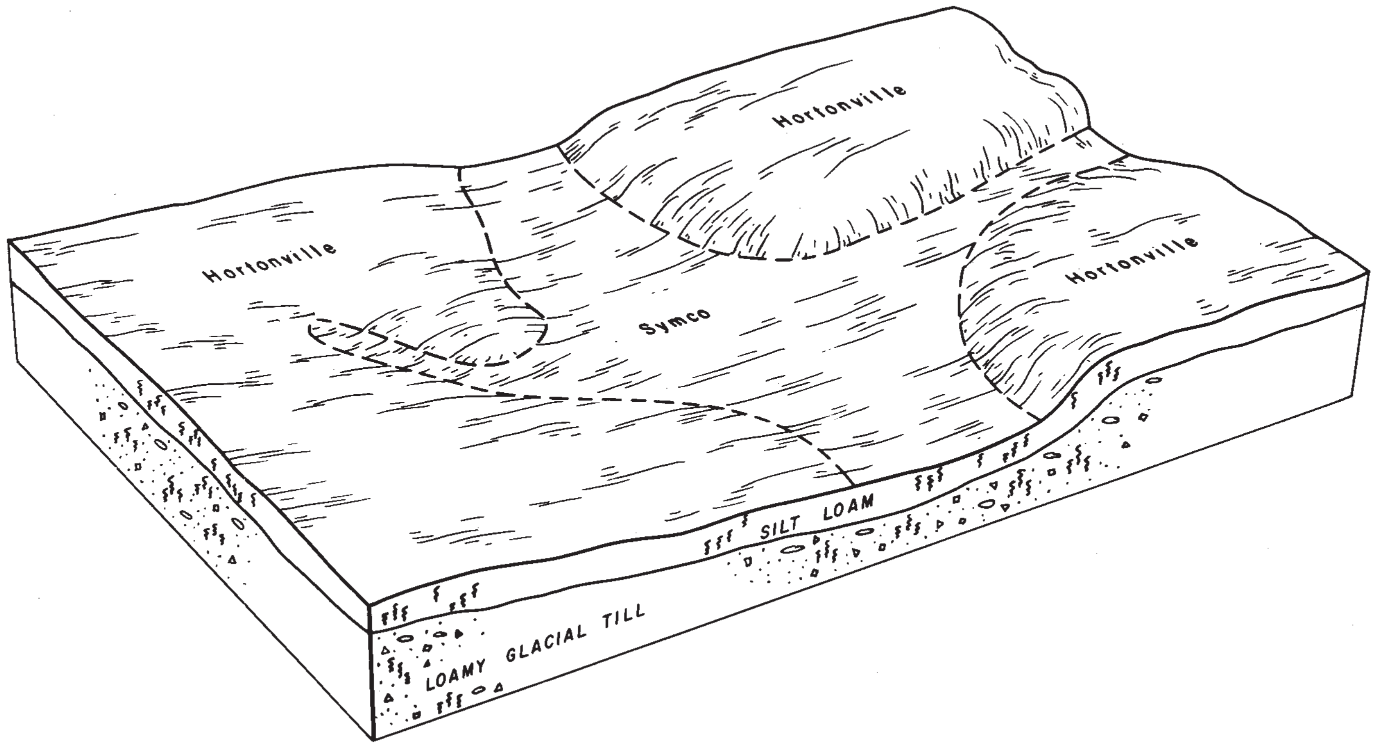


Figure 2.—Typical pattern of soils in the Hortonville-Symco map unit.

is very dark brown silt loam about 7 inches thick. The subsoil is about 15 inches thick. The upper part is brown, mottled, friable silty clay loam, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, mottled, firm silty clay.

Poygan soils are in depressions and drainageways on till plains and in lacustrine basins. They are nearly level and are poorly drained. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is about 9 inches thick. The upper part is grayish brown, mottled, firm silty clay, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, firm clay that has light gray secondary lime concretions.

The minor soils include the Kolberg, Mosel, Tustin, and Willette soils. Kolberg soils are gently sloping and sloping and are well drained. They are on convex knolls and are intermingled with Kewaunee soils. Kolberg soils are in areas where dolomite is at a depth of 20 to 40 inches. Mosel soils are nearly level and gently sloping and are somewhat poorly drained. They are in drainageways and on concave side slopes, and they are intermingled with Manawa soils. Mosel soils are in areas where loamy deposits as much as 36 inches thick overlie clay. Tustin soils are gently sloping and sloping and are well drained. They are on convex knolls where sandy deposits as much as 36 inches thick overlie clay. Willette soils are nearly level. They are in depressions and have 16 to 51 inches of organic material over clay.

The major soils in this map unit have good potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. The steeper soils and undrained wet soils are used for pasture or as wildlife habitat. In some small areas the soils are used as woodland. The main enterprise is growing crops for dairying. In some areas the soils are used for specialty crops, which include sweet corn, peas, beets, and beans.

The main management concerns in using the major soils for crops are controlling water erosion, improving drainage, and maintaining tilth and fertility.

The major soils in this map unit have severe limitations for use as septic tank absorption fields.

2. Hortonville-Symco

Nearly level to moderately steep, well drained and somewhat poorly drained soils that are loamy throughout

This map unit consists of soils on ground moraines made up of ridges, knolls, and plains that are dissected by drainageways. The soils are mostly nearly level to sloping, but along the sides of drainageways and on escarpments they are moderately steep.

This map unit makes up about 11 percent of the survey area. It consists of about 70 percent Hortonville soils, 20 percent Symco soils, and 10 percent minor soils (fig. 2).

Hortonville soils are on convex ridges and knolls on till plains and moraines. They are gently sloping to moderately steep and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 18 inches thick. The upper part is dark brown and brown, friable loam; the middle part is reddish brown, friable clay loam; and the lower part is reddish brown, friable loam. The substratum to a depth of 60 inches is reddish brown, friable loam.

Symco soils are on the concave lower side slopes and in drainageways on till plains and ground moraines. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, mottled, friable loam; the middle part is brown, mottled, friable clay loam; and the lower part is reddish brown, mottled, friable loam. The substratum to a depth of 60 inches is reddish brown, mottled, friable loam.

The minor soils include the Boyer, Brookston, Kewaunee, and Manawa soils. Boyer soils are gently sloping and sloping and are well drained. Kewaunee soils are gently sloping to steep. They are in similar positions on the landscape as the Hortonville soils and are intermingled throughout the area of this map unit. Brookston soils are nearly level and are very poorly drained. They are in depressions and broad drainageways. Manawa soils are nearly level and gently sloping and are somewhat poorly drained. They are in similar positions on the landscape as the Symco soils and are intermingled throughout the area of this map unit.

The soils in this map unit have good potential for the cultivated crops grown in the area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. Steeper soils and undrained wet soils are used for pasture or as wildlife habitat. In some small areas the soils are used as woodland. The main enterprise is growing crops for dairying. In some areas the soils are used for specialty crops, which include sweet corn, peas, beets, and beans.

The main management concerns in using the major soils for crops are controlling water erosion, improving drainage, and maintaining tilth and fertility.

The gently sloping and sloping Hortonville soils have moderate limitations for use as septic tank absorption fields. Symco soils and the moderately steep Hortonville soils have severe limitations for this use.

3. Hochheim-Lamartine-Mayville

Nearly level to moderately steep, well drained to somewhat poorly drained soils that are loamy throughout

This map unit consists of soils on ground moraines made up of broad knolls and ridges that are dissected by drainageways. The soils are mostly nearly level to sloping, but on the sides of drainageways and on escarpments they are moderately steep.

This map unit makes up about 9 percent of the survey area. It consists of about 50 percent Hochheim soils, 20 percent Lamartine soils, 15 percent Mayville soils, and 15 percent minor soils (fig. 3).

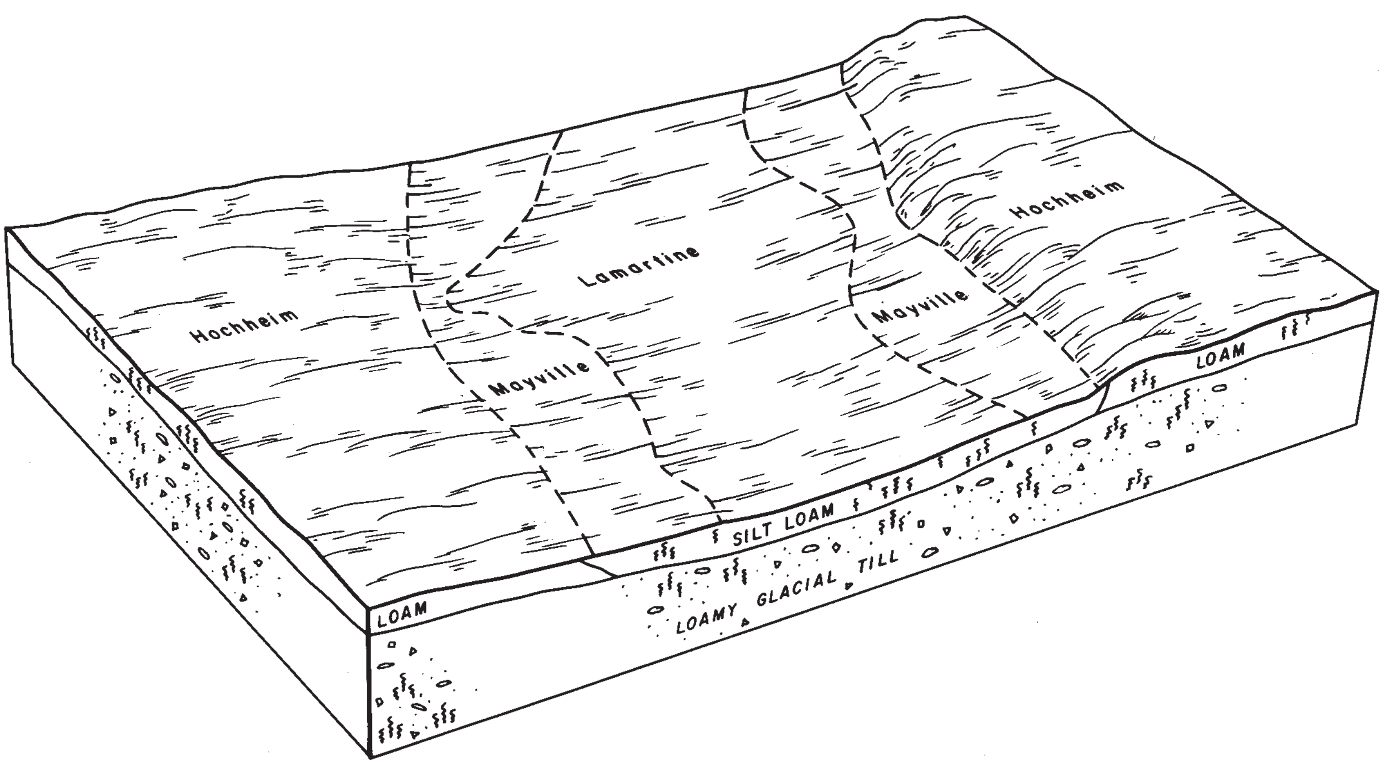


Figure 3.—Typical pattern of soils in the Hochheim-Lamartine-Mayville map unit.

Hochheim soils are on convex knolls on drumlins and ground moraines. They are gently sloping to moderately steep and are well drained. Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable loam; the middle part is dark brown, friable clay loam; and the lower part is dark yellowish brown, friable loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam.

Lamartine soils are on concave side slopes in drainageways and depressions on till plains. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick and dark brown silt loam 2 inches thick. The subsoil is about 22 inches thick. The upper part is dark yellowish brown, mottled, friable silt loam, and the lower part is brown, mottled, friable clay loam. The substratum to a depth of 60 inches is pale brown, mottled, friable loam.

Mayville soils are on concave lower side slopes on broad flats between drumlins on till plains. They are between Hochheim and Lamartine soils on the landscape. Mayville soils are nearly level and gently sloping and are moderately well drained. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 26 inches thick. The upper part is dark yellowish brown, friable silty clay loam and silt loam, and the lower part is yellowish brown and grayish brown, friable clay loam. The substratum to a depth of 60 inches is light yellowish brown, mottled, friable loam.

The minor soils include the Dodge, Pella, and Theresa soils. Dodge soils are gently sloping and are well drained. They are on slightly convex side slopes above the Mayville soils. Pella soils are nearly level and are poorly drained. They are in depressions and broad drainageways. Theresa soils are gently sloping and are well drained. They are intermingled with Hochheim soils throughout the area of this map unit. Theresa soils have a thicker silty mantle than the Hochheim soils.

The soils in this map unit have good potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. Steeper soils are used for pasture or as wildlife habitat. In some small areas the soils are used as woodland. The main enterprise is growing crops for dairying. In some areas the soils are used for specialty crops, which include sweet corn, peas, and beans.

The main management concerns in using the major soils for crops are controlling water erosion, improving drainage, and maintaining tilth and fertility.

Hochheim soils have moderate limitations for use as septic tank absorption fields. Mayville and Lamartine soils have severe limitations for this use.

Areas dominated by soils that formed in lacustrine deposits

This group of map units makes up about 10 percent of the survey area. The soils are nearly level to sloping. They formed in loamy and clayey deposits. They are well drained to poorly drained and are moderately permeable or moderately slowly permeable.

Most of the soils are in cropland. Corn, small grains, and hay are the major crops. Some of the soils are used for specialty crops, which include sweet corn, peas, beans, and beets. Undrained wet soils are used for pasture, as woodland, or as wildlife habitat.

Most soils in this group have poor potential for use as septic tank absorption fields because of wetness or slow permeability.

4. Zurich-Mundelein-Briggsville

Nearly level to sloping, well drained to somewhat poorly drained soils that have a loamy or clayey subsoil

This map unit consists of soils in glacial lake basins that are dissected by drainageways. The soils are mostly nearly level and gently sloping, but on the side slopes of drainageways they are sloping.

This map unit makes up about 3 percent of the survey area. It consists of about 40 percent Zurich soils, 15 percent Mundelein soils, 15 percent Briggsville soils, and 30 percent minor soils (fig. 4).

Zurich soils are on convex side slopes in glacial lake basins. They are gently sloping and sloping and are well drained. Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 15 inches thick. The upper part is dark brown, friable silty clay loam, and the lower part is brown, friable silt loam. The substratum to a depth of 60 inches is brown, mottled, friable silt loam.

Mundelein soils are on concave side slopes in glacial lake basins and depressions. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is brown, mottled, friable silt loam and silty clay loam about 17 inches thick. The substratum to a depth of 60 inches is pinkish gray and brown, stratified silt and very fine sand.

Briggsville soils are on convex knolls in glacial lake basins and on side slopes of drainageways. They are gently sloping and sloping and are well drained and moderately well drained. Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 25 inches thick. The upper part is reddish brown, friable silt loam, and the lower part is reddish brown, firm silty clay loam and silty clay. The substratum to a depth of 60 inches is reddish brown, mottled, stratified silt loam, silty clay loam, and fine sandy loam.

The minor soils include the Manawa, Nichols, Pella, and Shiocton soils. Manawa and Shiocton soils are nearly level and gently sloping. They are in similar positions on the landscape as the Mundelein soils and are intermingled throughout the area of this map unit. Manawa and Shiocton soils are somewhat poorly drained. Nichols soils are gently sloping and sloping and are well drained. Like the Zurich and Briggsville soils, they are in lake basins and on side slopes of drainageways. Pella soils are poorly drained; they are nearly level soils in depressions and broad drainageways.

The major soils in this map unit have good potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. Some sloping and undrained wet soils are used for pasture or as woodland. The main enterprises are growing crops for dairying and growing specialty crops, which include sweet corn, peas, beans, and beets.

The main management concerns in using the major soils for crops are controlling water erosion, improving drainage, and maintaining tilth and fertility.

The well drained Zurich soils have slight limitations for use as septic tank absorption fields. The moderately well drained Zurich, Mundelein, and Briggsville soils have severe limitations for this use.

5. Pella-Mundelein-Shiocton

Nearly level and gently sloping, somewhat poorly drained and poorly drained soils that are dominantly loamy throughout

This map unit consists of soils on till plains and in glacial lake basins. The soils are mostly nearly level, but in some areas they are gently sloping.

This map unit makes up about 6 percent of the survey area. It consists of about 30 percent Pella soils, 10 percent Mundelein soils, 10 percent Shiocton soils, and 50 percent minor soils.

Pella soils are on plane slopes in depressions on till plains. They are nearly level and are poorly drained. Typically, the surface layer is black silt loam about 10 inches thick. The subsoil is about 20 inches thick. It is grayish brown, mottled, friable silty clay loam. The upper part of the substratum is grayish brown, mottled, friable silty clay loam about 6 inches thick. The lower part of the substratum to a depth of 60 inches is grayish brown, mottled, friable silt loam.

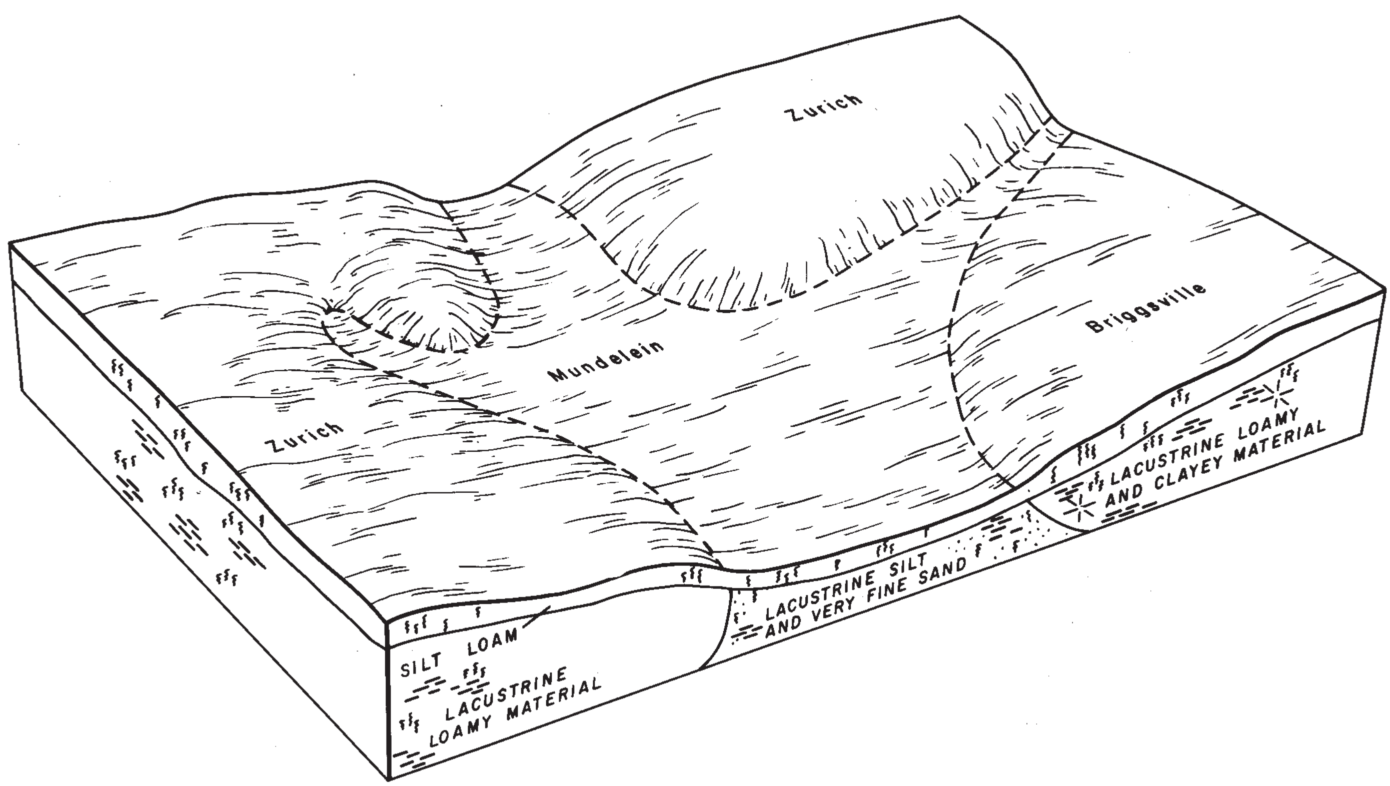


Figure 4.—Typical pattern of soils in the Zurich-Mundelein-Briggsville map unit.

Mundelein soils are on concave side slopes in glacial lake basins and depressions. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is brown, mottled, friable silt loam and silty clay loam about 17 inches thick. The substratum to a depth of 60 inches is pinkish gray and brown, stratified silt and very fine sand.

Shiocton soils are on concave side slopes in drainageways in glacial lake basins. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The subsoil is 12 inches thick. It is yellowish brown and light reddish brown, mottled, very friable very fine sandy loam. The substratum to a depth of 60 inches is mostly yellowish brown, reddish brown, and light reddish brown, mottled very fine sand; there are strata of silt in the lower part.

The minor soils include the Cosad, Manawa, Poygan, and Wauseon soils. Manawa and Cosad soils are in lake basins and drainageways. They are in positions on the landscape similar to those of Shiocton and Mundelein soils and are intermingled throughout the area of this map unit.

The major soils in this map unit, if drained, have good potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and hay. Some undrained soils are used for pasture or as wildlife habitat. In some small areas the soils are used as woodland. The main enterprise is growing crops for dairying.

The main management concerns in using the major soils for crops are improving drainage and maintaining tilth and fertility.

All of the major soils in this map unit have severe limitations for use as septic tank absorption fields.

Areas dominated by soils that formed in glacial drift

This group of map units makes up about 11 percent of the survey area. The soils are gently sloping to steep. They formed on a complex topography of moraines, outwash terraces, and lacustrine plains. They are well drained and moderately well drained and are very rapidly permeable to slowly permeable.

Most of the soils are in cropland. Corn, small grains, and hay are the major crops. Moderately steep soils and some sloping soils are used for pasture or as woodland.

Most gently sloping soils in this group have good potential for use as septic tank absorption fields. Moderately steep and steep soils and slowly permeable, gently sloping soils have poor potential for this use.

6. Kewaunee-Boyer-Nichols

Gently sloping to steep, well drained and moderately well drained soils that are sandy, loamy, or clayey

This map unit consists of soils on moraines, outwash terraces, and lacustrine plains. The soils are mostly gently sloping and sloping, but on the sides of moraines and drumlins they are steep.

This map unit makes up about 8 percent of the survey area. It consists of about 30 percent Kewaunee soils, 15 percent Boyer soils, 10 percent Nichols soils, and 45 percent minor soils (fig. 5).

Kewaunee soils are on convex knolls and hills on moraines and drumlins on till plains. They are gently sloping to steep and are well drained. Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay.

Boyer soils are on moraines, outwash plains, and terraces. They are gently sloping to moderately steep and are well drained. Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick and pale brown sandy loam about 3 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, friable sandy loam; the middle part is brown, friable gravelly sandy clay loam; and the lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel.

Nichols soils are on convex knolls on lacustrine plains. They are gently sloping and sloping and are well drained and moderately well drained. Typically, the surface layer is dark brown very fine sandy loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is pale brown, friable very fine sandy loam, and the lower part is light brown, mottled, friable very fine sandy loam. The substratum to a depth of 60 inches is very pale brown, mottled, friable very fine sand that has thin silt bands.

The minor soils include the Manawa, Pella, Poygan, Shiocton, and Wasepi soils. Manawa, Shiocton, and Wasepi soils are nearly level and gently sloping. They are on concave side slopes and in drainageways. Manawa soils are somewhat poorly drained and are in drainageways adjacent to the Kewaunee soils. Shiocton soils are somewhat poorly drained and are in drainageways adjacent to the Nichols soils. Wasepi soils are somewhat poorly drained and are in drainageways adjacent to the Boyer soils. Pella and Poygan soils are poorly drained and are in depressions.

The major soils in this map unit have fair or good potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. Some moderately steep soils are used for pasture or as wildlife habitat. In some small areas the soils are used as woodland. The main enterprise is growing crops for dairying.

The main management concerns in using the major soils for crops are controlling water erosion and maintaining tilth and fertility.

Kewaunee soils have severe limitations for use as septic tank absorption fields. The gently sloping Boyer and Nichols soils have slight limitations and the sloping

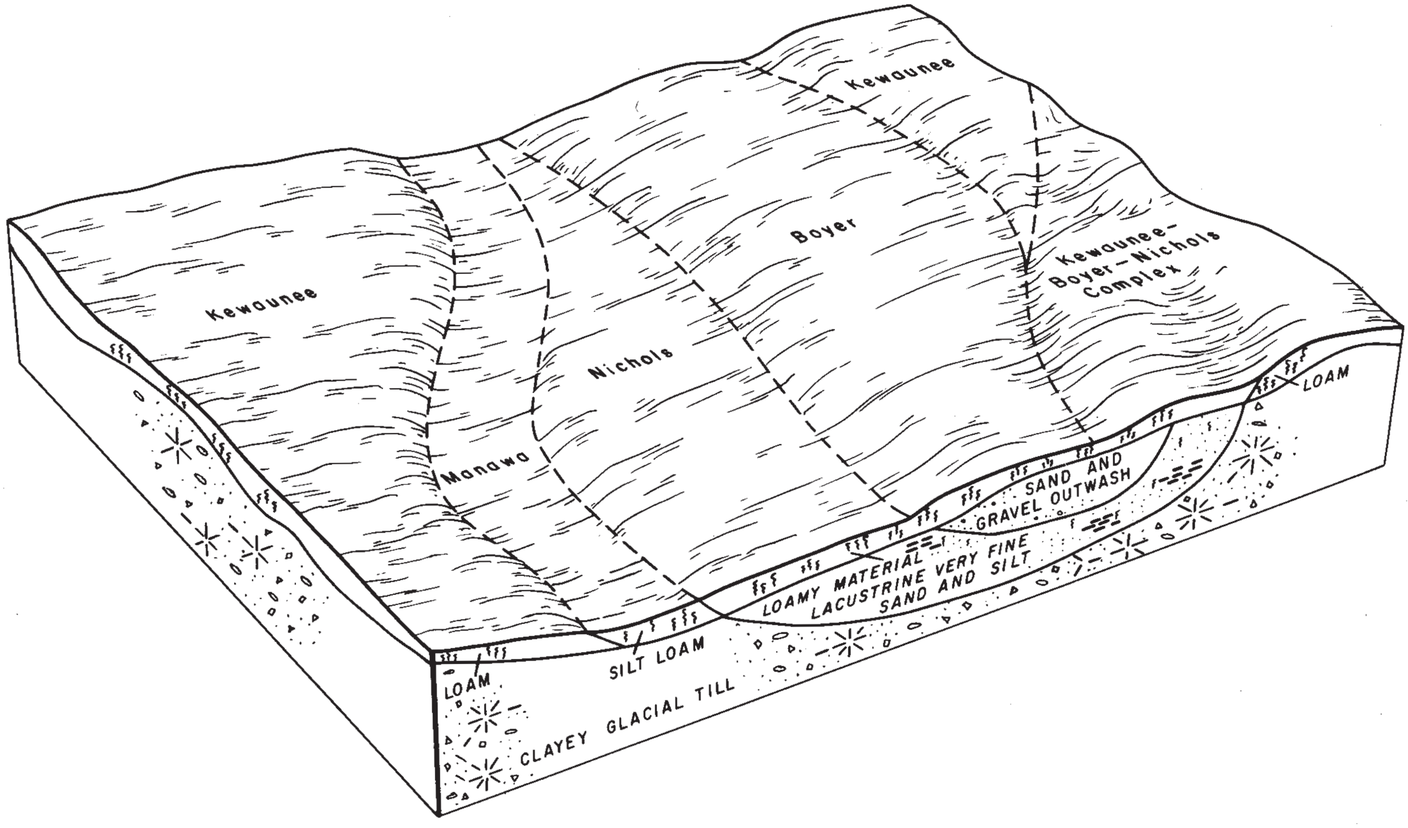


Figure 5.—Typical pattern of soils in the Kewaunee-Boyer-Nichols map unit.

Boyer and Nichols soils have moderate limitations for this use.

7. Hochheim-Lutzke

Gently sloping to steep, well drained loamy soils

This map unit consists of soils on moraines and kames. The soils are mostly sloping and moderately steep.

This map unit makes up about 3 percent of the survey area. It consists of about 45 percent Hochheim soils, 30 percent Lutzke soils, and 25 percent minor soils.

Hochheim soils are on convex knolls on drumlins and ground moraines. They are gently sloping to steep and are well drained. Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part is dark yellowish brown, friable loam; the middle part is dark brown, friable clay loam; and the lower part is dark yellowish brown, friable loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam.

Lutzke soils are on convex knolls on outwash plains, terraces, eskers, and kames. They are gently sloping to moderately steep and are well drained. Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark brown, friable gravelly clay loam, and the lower part is dark brown, friable gravelly loam. The substratum to a depth of 60 inches is brown, loose very gravelly sand.

The minor soils include the Nichols, Symco, and Wasepi soils. Nichols soils are gently sloping and sloping and are well drained and moderately well drained. They are on convex knolls in old lake basins. Symco and Wasepi soils are nearly level and gently sloping and are somewhat poorly drained. They are on concave side slopes and in drainageways.

The major soils in this map unit have fair to poor potential for cultivated crops but have good potential for use as woodland. Most of the soils are used as pasture or woodland. Less sloping soils are used as cropland. Some soils are a source of sand and gravel.

The main management concerns in using the major soils for crops are controlling erosion and maintaining tilth and fertility.

The sloping soils have moderate limitations and the moderately steep soils have severe limitations for use as septic tank absorption fields. The gently sloping soils have slight limitations for this use.

Areas dominated by soils that are underlain by outwash deposits

This group of map units makes up about 6 percent of the survey area. The soils are nearly level to moderately steep. They formed in sandy or loamy deposits and are underlain by sand or by sand and gravel. They are excessively drained to poorly drained and are rapidly permeable or very rapidly permeable in the substratum.

Some of the soils are in cropland. Corn, small grains, and hay are the major crops. Other soils in this group are used as woodland or wildlife habitat.

The gently sloping soils on knolls have good potential for use as septic tank absorption fields. The nearly level and gently sloping soils on concave side slopes have poor potential for this use because of wetness.

8. Wasepi-Plainfield-Boyer

Nearly level to moderately steep, excessively drained to somewhat poorly drained, sandy and loamy soils

This map unit consists of soils on moraines, terraces, and outwash plains that are dissected by large drainageways. The soils are mostly nearly level and gently sloping, but on the side slopes of drainageways and on escarpments they are sloping and moderately steep.

This map unit makes up about 2 percent of the survey area. It consists of about 40 percent Wasepi soils, 25 percent Plainfield soils, 15 percent Boyer soils, and 20 percent minor soils.

Wasepi soils are in drainageways and on concave side slopes of depressions on outwash plains and stream terraces. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is very dark brown sandy loam about 7 inches thick and brown, mottled sandy loam about 4 inches thick. The subsoil is about 12 inches thick. The upper part is yellowish brown, mottled, friable sandy loam, and the lower part is brownish yellow, mottled, friable gravelly loamy sand. The substratum to a depth of 60 inches is light brownish gray, mottled, loose sand and gravel.

Plainfield soils are on convex knolls on stream terraces, on escarpments, and on the sides of moraines. They are gently sloping to moderately steep and are excessively drained. Typically, the surface layer is dark brown loamy sand about 13 inches thick. The subsoil is about 13 inches thick. The upper part is strong brown, very friable sand, and the lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is strong brown and light yellowish brown, loose sand.

Boyer soils are on convex knolls on moraines, outwash plains, and terraces. They are gently sloping and sloping and are well drained. Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick and pale brown sandy loam about 3 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, friable sandy loam; the middle part is brown, friable gravelly sandy clay loam; and the lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel.

The minor soils include the Granby, Lutzke, and Oakville soils. Granby soils are nearly level, are poorly drained, and are in depressions. Lutzke soils are gently sloping to moderately steep and are well drained. Oakville soils are nearly level to sloping and are well drained. Lutzke and Oakville soils are intermingled on convex knolls and on side slopes along drainageways.

The major soils in this map unit have fair to poor potential for the cultivated crops commonly grown in the survey area. Most of the soils are used for cultivated crops such as corn, small grains, and alfalfa. In some small areas the soils are used for pasture, as woodland, or as wildlife habitat. Some soils are used as a source of sand and gravel. The main enterprise is growing crops for dairying.

The main management concerns in using the major soils for crops are controlling erosion and soil blowing, improving drainage, and maintaining tilth and fertility.

Wasepi soils have severe limitations for use as septic tank absorption fields. The gently sloping Plainfield and Boyer soils have slight limitations and the sloping Plainfield and Boyer soils have moderate limitations for this use.

9. Granby-Oakville-Tedrow

Nearly level to sloping, well drained to poorly drained soils that are dominantly sandy throughout

This map unit consists of soils on outwash plains that are dissected by drainageways and on old beaches and lake plains. The soils are mostly nearly level and gently sloping, but on the side slopes of drainageways and in depressions they are sloping.

This map unit makes up about 4 percent of the survey area. It consists of about 30 percent Granby soils, 25 percent Oakville soils, 10 percent Tedrow soils, and 35 percent minor soils.

Granby soils are in broad depressions and drainageways on outwash plains and old beaches. They are nearly level and are poorly drained. Typically, the surface layer is black fine sandy loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is brown, mottled, friable loamy fine sand, and the lower part is light yellowish brown, mottled, loose fine sand. The substratum to a depth of 60 inches is brown, mottled, loose fine sand.

Oakville soils are on convex ridges and knolls on beach ridges and lake plains. They are nearly level to sloping and are well drained. Typically, the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 29 inches thick. The upper part is strong brown, friable fine sand, and the lower part is yellowish brown, loose fine sand. The substratum to a depth of 60 inches is white, loose fine sand.

Tedrow soils are on concave side slopes in drainageways on lake plains and old beaches. They are nearly level and gently sloping and are somewhat poorly drained. Typically, the surface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is about 18 inches thick. The upper part is strong brown, friable fine sand, and the lower part is yellowish brown, mottled, loose fine sand. The substratum to a depth of 60 inches is yellowish brown, mottled, loose fine sand.

The minor soils include the Adrian, Cosad, and Tustin soils. Adrian soils are nearly level and very poorly drained. They are in depressions and are mostly surrounded by Granby soils. Cosad soils are nearly level and gently sloping and are somewhat poorly drained. They are on concave side slopes and in drainageways. Cosad soils are in positions on the landscape similar to those of the Tedrow soils. Tustin soils are gently sloping and are well drained. They are on convex ridges and knolls. Tustin soils are in similar positions on the landscape as the Oakville soils.

The major soils in this map unit have poor potential for the crops commonly grown in the survey area and for woodland. Most of the soils are used as woodland and wildlife habitat. In some small areas the soils are used for pasture or cropland. Most of this map unit is in a state park.

The main management concerns in using the major soils for crops are controlling soil blowing, improving drainage, and maintaining fertility.

Granby and Tedrow soils have severe limitations for use as septic tank absorption fields. The gently sloping Oakville soils have slight limitations for this use.

Areas dominated by organic soils

Map unit 10 makes up about 9 percent of the survey area. The soils are nearly level. They formed in organic material that is more than 16 inches thick. They are very poorly drained and are moderately rapidly permeable in the upper part. The substratum is moderately rapidly permeable to very slowly permeable.

Most of the soils are in natural vegetation of trees and sedges. In some small areas the soils are used for pasture. Most of the soils have poor potential for cropland.

These soils have poor potential for use as septic tank absorption fields because of wetness.

10. Houghton-Palms-Willette

Nearly level, very poorly drained organic soils

This map unit consists of soils in glacial lake basins and on till plains.

This map unit makes up about 9 percent of the survey area. It consists of about 50 percent Houghton soils, 15 percent Palms soils, 10 percent Willette soils, and 25 percent minor soils.

Houghton soils are in depressions in glacial lake basins. They are nearly level and are very poorly drained. Typically, the organic layer is black and dark yellowish brown muck to a depth of about 72 inches.

Palms soils are in depressions in glacial lake basins. They are nearly level and are very poorly drained. Typically, the organic layer is black, very dark grayish brown, and very dark brown muck about 36 inches thick. The substratum to a depth of 60 inches is gray stratified silt and very fine sand.

Willette soils are in depressions on till plains and in glacial lake basins. They are nearly level and are very poorly drained. Typically, the organic layer is black muck about 28 inches thick. The substratum to a depth of 60 inches is dark gray silty clay in the upper part and brown silty clay in the lower part.

The minor soils include the Adrian, Pella, and Poygan soils. Adrian soils are nearly level and are very poorly drained. They are organic soils in depressions and bogs. They have a sand substratum. Pella and Poygan soils are nearly level and are poorly drained. They are in a slightly higher position on the landscape and surround the major soils in this map unit.

Most of the soils are in natural vegetation of trees and sedges, which provide habitat for wildlife. In some small areas the soils are used for pasture. The major soils have poor potential for crops, pasture, and woodland.

The main management concerns in using the major soils for crops are improving drainage and controlling soil blowing and subsidence.

The major soils have severe limitations for use as septic tank absorption fields.

Areas dominated by soils that are underlain by dolomite

Map unit 11 makes up about 1 percent of the survey area. The soils are gently sloping and sloping. They formed in loamy and clayey deposits over dolomite. They are well drained and are moderately permeable or moderately slowly permeable.

Most of the soils are used as cropland. In some areas the soils are used as woodland, for pasture, or as wildlife habitat. The bedrock in some areas is a source of stone for construction and for agricultural lime.

Most of the soils have poor potential for use as septic tank absorption fields because of depth to rock.

11. Channahon-Whalan-Kolberg

Gently sloping and sloping, well drained loamy soils that have a dolomite substratum

This map unit consists of soils on uplands where dolomite is within 10 to 40 inches of the surface.

This map unit makes up about 1 percent of the survey area. It consists of about 40 percent Channahon soils, 25 percent Whalan soils, 20 percent Kolberg soils, and 15 percent minor soils.

Channahon soils are on convex knolls and ridges on uplands. They are gently sloping and sloping and are well drained. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 10 inches thick. The upper part is dark brown, friable clay loam, and the lower part is light brown, friable clay loam. The substratum, at a depth of about 18 inches, is white dolomite.

Whalan soils are on convex knolls and ridges on uplands. They are gently sloping and are well drained. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 20 inches thick. The upper part is brown and dark brown, friable silt loam, and the lower part is reddish brown, firm silty clay. The substratum, at a depth of 32 inches, is light gray dolomite.

Kolberg soils are on convex knolls and ridges on uplands. They are gently sloping and sloping and are well drained. Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 21 inches thick. The upper part is reddish brown, firm clay loam; the middle part is reddish brown, firm clay; and the lower part is reddish brown, firm gravelly clay loam. The substratum, at a depth of about 29 inches, is white fractured dolomite.

The minor soils include the Kewaunee and Hochheim soils. Kewaunee soils are gently sloping to steep and are well drained. Hochheim soils are gently sloping to moderately steep and are well drained. Kewaunee and Hochheim soils are on convex knolls and ridges where the dolomite is more than 60 inches from the surface.

The major soils in this map unit have fair to poor potential for use as cropland and good potential for use as woodland. Most of the soils are used as cropland. Some sloping to steep soils are used as woodland, for pasture, or as wildlife habitat. The substrata of the major soils are a source of stone for construction and for agricultural lime. The main enterprise is growing crops for dairying.

The main management concerns in using the major soils for crops are controlling erosion and maintaining tilth and fertility.

The major soils in this map unit have severe limitations for use as septic tank absorption fields.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Hochheim loam, 2 to 6 percent slopes, is one of several phases within the Hochheim series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Oakville-Granby complex, 0 to 4 percent slopes, is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Dune land is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 3, and information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

Ac—Adrian muck. This soil is nearly level and very poorly drained. It is in depressions in old glacial lake basins that are subject to frequent flooding. The areas are irregular in shape and range from 5 to 80 acres in size. Slopes range from 0 to 2 percent.

Typically, the upper layer is black muck about 12 inches thick. Below this is dark reddish brown muck about 28 inches thick. The substratum to a depth of 60 inches is brown, loose sand. In small areas this soil has thin layers of mucky peat and peat above the substratum.

Included with this soil in mapping are small areas of Granby soils, which make up as much as 5 percent of this map unit. Granby soils are poorly drained and are in slightly higher positions on the landscape than the Adrian soil.

Permeability is moderately rapid in the organic layer and rapid in the substratum. The available water capacity is very high. Runoff is slow. The shrink-swell potential is low in the substratum. Most plant roots are restricted in this soil by the high water table. This soil is neutral or mildly alkaline. The organic matter content is very high, and natural fertility is low. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil are in natural vegetation. This soil has fair potential for specialty crops and poor potential for building site development and sanitary facilities.

This soil is poorly suited to cropland. A short growing season due to frost late in spring and early in fall limits the type of crops that can be grown. Most areas also do not have an adequate outlet for surface and subsurface drainage systems. Specialized equipment that does not become mired when cultivating and harvesting is needed. There is a hazard of soil blowing and of subsidence in areas that are artificially drained and are used as cropland.

This soil is poorly suited to pasture. The surface layer has very poor trafficability, and the use of this soil is restricted to dry periods.

This soil is poorly suited to woodland use. It has severe limitations for equipment operation. The hazards of windthrow, seedling mortality, and plant competition are severe. Harvesting operations are restricted to winter, when the ground is frozen. Planting on ridges generally is done by hand. Trees on this soil are shallow rooted, and windthrow is a severe hazard. Clearcutting or area selection harvesting can overcome this hazard. Flooding is frequent, and seedling survival is difficult because of the waterlogged soil. Spraying or scalping the existing grasses and sedges can control plant competition. Older trees that are tolerant of waterlogged conditions grow rapidly. Roads or streets through areas of this soil should be planned so that the ground water flow is not hindered.

This soil is poorly suited to building site development because of flooding, wetness, and the low strength of the organic material. Local roads and streets constructed on this soil are subject to damage from wetness, frost heave, and subsidence; therefore, all organic material should be removed, and coarse-textured base material should be added. A drainage system is needed to remove excess water from the road area. This soil is poorly suited to use as septic tank absorption fields because of flooding and wetness.

Capability subclass IVw; woodland suitability subclass 3w.

As—Aquents, sloping. These soils are gently sloping and sloping and somewhat poorly drained and poorly drained. They are in seepage areas below springs and on slopes adjacent to rivers. The areas are long and narrow and range from 5 to 60 acres in size. Slopes range from 3 to 12 percent.

These soils have a wide range of texture and are too variable to classify except at the higher and broader levels of soil classification. Typically, the surface layer is black silt loam or muck. The substratum is gray sandy loam, loam, or clay.

Included with these soils in mapping are small areas of Mosel, Palms, and Shiocton soils, which make up about 10 percent of this map unit. Palms soils are very poorly drained. Mosel and Shiocton soils are somewhat poorly drained.

Aquents, sloping, have a wide range of soil properties. They are saturated to a depth of less than 3 feet during most of the year.

Most areas of these soils are used for woodland, and some small areas are used for pasture. These soils have poor potential for almost all uses. Onsite investigation is needed to determine the potential for all new land use.

These soils are poorly suited to corn and small grains and to grasses and legumes for hay. Artificial drainage is difficult to install because of slope and continuous seepage of water. There is a hazard of erosion in drained areas.

These soils are poorly suited to pasture. Grazing should be restricted to the short periods when the surface of these soils is dry.

These soils are poorly suited to woodland use. Harvesting is restricted to winter, when the ground is frozen. Seedling mortality is moderate because of wetness. Trees on these soils should be maintained and harvested only when they reach maturity. The hazard of windthrow is moderate.

These soils have poor potential for wildlife habitat because of wetness and slope. Because of slope, open water areas cannot be built, but small ponds that have dams on the lower side can be built.

These soils are poorly suited to building site development and sanitary facilities because of wetness, low strength, and frost action.

Capability subclass Vw; not assigned to a woodland suitability subclass.

BcA—Bellevue silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and moderately well drained. It is on flood plains that are subject to frequent flooding. The areas are long and narrow and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is about 24 inches thick; it is reddish brown, friable loam and has mottles in the lower part. The substratum to a depth of 60 inches is dark reddish brown, mottled loam.

Included with this soil in mapping are small areas of Boyer and Wasepi soils and Fluvaquents, which make up 5 to 15 percent of this map unit. Boyer soils are well drained and are slightly higher on the landscape than the Bellevue soil. Fluvaquents are poorly drained and are below the Bellevue soil on the landscape. Wasepi soils are somewhat poorly drained and are in drainageways.

Permeability is moderate, and the available water capacity is high. The surface layer is friable and is easily tilled. The shrink-swell potential is low. Some plant roots are restricted by wetness at a depth of 3 to 5 feet. This soil is mildly alkaline throughout. The organic matter content is moderate, and natural fertility is high. This soil is saturated to a depth of 3 to 5 feet during wet periods.

Most areas of this soil are in pasture or woodland. This soil has fair potential for cultivated crops and pasture and good potential for trees. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grains. Frequent flooding is a hazard. Alfalfa is restricted by wetness.

This soil is suited to pasture. Overgrazing or grazing when the soil is wet can cause surface compaction. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; many areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well, but they can be damaged by frequent flooding. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development because of frequent flooding, low strength, and piping. Buildings and structures should be protected from flooding. Construction practices to overcome low strength and piping are also needed. Using adequate reinforcing steel in concrete foundations, backfilling with sand and gravel, installing foundation drains, and oversizing foundations are effective practices that help reduce damage due to low strength and piping. This soil is not suited to use as sites for sanitary facilities because of flooding. Local roads and streets are subject to damage caused by flooding and frost action. Placing a thick layer of suitable roadfill on the subsoil can overcome frost action.

Capability subclass IIIw; woodland suitability subclass 3o.

BrB—Boyer sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on outwash plains and terraces. The areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick and pale brown sandy loam about 3 inches thick. The subsoil is about 20 inches thick. The upper part is dark yellowish brown, friable sandy loam; the middle part is brown, friable gravelly sandy clay loam; and the lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel. In some areas of this soil the surface layer is loamy sand, and the subsoil is loam. Some small areas have many surface stones. Other small areas have slopes of slightly more than 6 percent.

Included with this soil in mapping are small areas of Lutzke, Plainfield, and Wasepi soils, which make up 5 to 15 percent of this map unit. Lutzke and Plainfield soils are in positions on the landscape similar to that of the Boyer soil. Lutzke soils are well drained. Plainfield soils are excessively drained. Wasepi soils are somewhat poorly drained and are in drainageways.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. Runoff is slow. The surface layer is easily tilled. The shrink-swell potential is low. Most plant roots are restricted by the sand and gravel substratum. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is low to moderate, and natural fertility is low.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, pasture, and trees. It has good potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields are limited in most years by the low available water capacity. There is a hazard of soil blowing and a slight hazard of erosion in areas that are not protected by cover crops. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas the slopes are long and uniform and therefore suitable for contour tillage. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and the infiltration rate. Some large areas of this soil have potential for sprinkler irrigation.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing can damage the vegetative cover and cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition.

This soil is fairly suited to trees. A few small areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well. The low available water capacity of this soil reduces tree growth. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is suitable for building site development. Excavation cutbanks can cave in. Pollution of ground water from septic tank effluent can be a problem. The sand and gravel substratum of this soil provides a stable base for foundations. This soil is a good source of sand and gravel for roads and construction use.

Capability subclass IIIs; woodland suitability subclass 3o.

BrC2—Boyer sandy loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on the side slopes of ridges on outwash plains and terraces. The areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is brown sandy loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, friable sandy loam; the middle part is brown, friable gravelly sandy clay loam; and the lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel. In some small areas this soil has slopes of slightly more than 12 percent. In other small areas the soil is uneroded. In some areas there are many surface stones.

Included with this soil in mapping are small areas of Lutzke, Plainfield, and Wasepi soils and small areas of Boyer soils that are severely eroded. These included soils make up 5 to 15 percent of this map unit. Lutzke and Plainfield soils are in a position on the landscape similar to that of the Boyer soil. Lutzke soils are well drained. Plainfield soils are excessively drained. Wasepi soils are somewhat poorly drained and are in drainageways.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. Runoff is medium. The surface layer is friable and can be easily tilled. The shrink-swell potential is low. Root growth is restricted for most plants by the sand and gravel substratum. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is low to moderate, and natural fertility is low.

Most areas of this soil are farmed, and other areas are used as pasture or woodland. This soil has fair potential for cultivated crops, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. There is a moderate hazard of erosion. To prevent additional soil loss, this soil is best suited to close growing crops. Where cultivated row crops such as corn are grown, erosion can remove large quantities of the surface layer. Because some of the subsoil is exposed, this soil is more difficult to till than soils in uneroded areas. Crop yields are limited in most seasons by the low available water capacity. Soil blowing is also a concern in areas that are not protected by a cover crop. Minimum tillage, winter cover crops, spring plowing, contour tillage, grassed waterways, and long rotations that include only a year of corn help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve the infiltration rate and fertility.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing can cause damage to the vegetative cover, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. The low available water capacity of this soil reduces tree growth. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to building site development because of slope. Excessive leveling exposes the sand and gravel substratum, which is difficult to revegetate. Excavation cutbanks can cave in. Pollution of ground water from the septic tank effluent can be a problem. The sand and gravel substratum of this soil provides a stable base for foundations. It is a good source of material for roads and construction.

Capability subclass IIIe; woodland suitability subclass 3o.

BsB—Boyer sandy loam, loamy substratum, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on outwash plains, terraces, and edges of lake basins. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 5 inches thick. The subsurface layer is yellowish brown sandy loam about 5 inches thick. The subsoil is about 17 inches thick; the upper part is brown, friable gravelly loam, and the lower part is strong brown, very friable gravelly sandy loam. The substratum in the upper part is strong brown, loose sand and gravel 21 inches thick. In the lower part to a depth of 60 inches it is light gray banded silt and very fine sand. In some areas of this soil the surface layer is loamy sand.

Included with this soil in mapping, and making up 5 to 15 percent of this map unit, are small areas of Nichols and Plainfield soils and small areas of soils that have yellowish brown mottles in the lower part of the substratum. Nichols and Plainfield soils are in positions on the landscape similar to those of this Boyer soil. Nichols soils are well drained and moderately well drained. Plainfield soils are excessively drained. The soils that are mottled in the lower part of the substratum are moderately well drained and are in lower positions on the landscape than the Boyer soil.

Permeability is moderately rapid in the subsoil, very rapid in the upper part of the substratum, and moderate in the lower part of the substratum. The available water capacity is moderate. Runoff is slow. The surface layer is easily tilled. The shrink-swell potential is low. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is low to moderate, and natural fertility is low.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. Corn yields are limited in most years by the moderate available water capacity. There is a hazard of soil blowing and a slight hazard of erosion in areas that are not protected by cover crops. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In some areas the slopes are long and uniform and therefore suitable for contour tillage. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and the infiltration rate. Some large areas of this soil have potential for sprinkler irrigation.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing can cause damage to the vegetative cover, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are slight limitations in planting or harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is suited to building site development. Septic tank absorption fields should be placed in the upper part of the substratum. Foundations that extend into the lower part of the substratum are subject to cracking due to the low strength of this soil. Drainage tile should be installed around basements to prevent wetness due to the abrupt textural change between the upper and lower parts of the substratum. Local roads and streets are subject to moderate frost action, which can be overcome by applying a thick layer of suitable roadfill.

Capability subclass IIIs; woodland suitability subclass 3o.

BtB—Briggsville silt loam, 2 to 6 percent slopes. This soil is gently sloping and moderately well drained. It is on convex slopes in glacial lake basins and on side slopes of drainageways. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 25 inches thick; the upper part is reddish brown, friable silt loam, and the lower part is reddish brown, firm silty clay loam and silty clay. The substratum to a depth of 60 inches is reddish brown, mottled, stratified silt loam, silty clay loam, and fine sandy loam. In some small areas 3 to 5 inches of the surface layer has been lost by erosion. In other small areas the surface layer is darker colored.

Included with this soil in mapping are small areas of Manawa and Nichols soils, which make up 3 to 8 percent of this map unit. Manawa soils are somewhat poorly drained and are in slightly lower positions on the landscape than the Briggsville soil; they are in shallow depressions and drainageways. Nichols soils are well drained and moderately well drained and are in a position on the landscape similar to that of the Briggsville soil. Also included are small areas of a well drained, steeper Briggsville soil.

Permeability is moderately slow, and the available water capacity is high. Runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderately low, and natural fertility is medium. This soil is saturated to a depth of 3 to 5 feet in wet periods. Water may collect in the lower areas for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay. It is also well suited to specialty crops such as peas, carrots, green beans, and beets for canning; many areas of this soil are used for these specialty crops. Wetness to a depth of 3 to 5 feet can limit yields of alfalfa. There is a slight hazard of water erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas the slopes are long and uniform and therefore suitable for contour tillage. Terraces and diversions can be used to break the length of slopes. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and the infiltration rate.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use in wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development because of low strength, frost action, and wetness. Construction practices such as backfilling with sand and gravel, installing foundation drains, and using adequate reinforcing steel in concrete are necessary to offset the low strength and wetness of the soil. Because local roads and streets are subject to damage from low strength and frost heave, placing a thick layer of suitable roadfill on the subsoil is needed. Sanitary facilities do not work well on this soil because of the moderately slow permeability and wetness. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIe; woodland suitability subclass 2c.

BtC2—Briggsville silt loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on convex slopes in dissected glacial lake basins and along drainageways. The areas are long and narrow and range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 19 inches thick; the upper part is reddish brown, firm silty clay loam, and the lower part is reddish brown, firm silty clay. The substratum to a depth of 60 inches is reddish brown, stratified silty clay, silt, and fine sandy loam. In some small areas this soil is not eroded.

Included with this soil in mapping, and making up 5 to 10 percent of this map unit, are small areas of Nichols soils, Briggsville soils that are severely eroded, and Briggsville soils that have slopes of more than 12 percent. The Nichols soils are well drained and moderately well drained and are in a position on the landscape similar to that of the Briggsville soil. The severely eroded Briggsville soils are on the top and sides of small crests and rises.

Permeability is moderately slow, and the available water capacity is high. Runoff is medium or rapid. The surface layer is friable, but it generally has a narrow range of moisture content within which it can be tilled without crusting. In small areas that are severely eroded, the range of suitable moisture content is very narrow. These severely eroded areas are scattered throughout this map unit, and they control the time of tillage for the entire unit. The upper part of the subsoil is neutral and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderately low, and natural fertility is medium.

Most areas of this soil are farmed. This soil has good potential for hay, pasture, and trees and fair potential for row crops. It has poor potential for most building site development and sanitary facilities.

This soil is well suited to small grains and to grasses and legumes for hay. The high reaction of this soil makes it especially well suited to legumes. There is a moderate hazard of erosion. There is a severe hazard of erosion in small areas that have slopes of more than 12 percent. If this soil is used for row crops, there is a hazard of further erosion. This soil is subject to crusting that results in poor emergence of small seeded crops. Because the subsoil is exposed in some places, this soil is more difficult to till than uneroded soils. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. In a few areas slopes are long enough and uniform enough for contour tillage. Diversions can be used to break the length of slopes. Maintaining the organic matter content helps prevent erosion, increase the infiltration rate, and reduce crusting. Returning crop residue to the soil or adding other organic material helps improve fertility, tilth, and soil moisture retention.

Using this soil for hay and pasture is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is well suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to most building site development because of slope, low strength, and frost action. Construction practices such as backfilling with sand and gravel, installing foundation drains, and using adequate reinforcing steel in concrete are necessary to control low strength. Local roads and streets are subject to damage because of low strength and frost heave; therefore, a thick layer of suitable roadfill is needed over the subsoil. Sanitary facilities do not work well in this soil because of the moderately slow permeability. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIIe; woodland suitability subclass 2c.

Bu—Brookston silt loam. This soil is nearly level and very poorly drained. It is in depressions and broad drainageways on till plains that are subject to frequent flooding. The areas are irregular in shape and range from 5 to 300 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is black silt loam about 12 inches thick. The subsoil is about 13 inches thick; the upper part is dark gray, mottled, friable clay loam, and the lower part is brown, mottled, friable loam. The substratum to a depth of 60 inches is brown, mottled loam. Small areas of this soil have as much as 6 inches of muck on the surface. In other small areas gravel and cobblestones make up as much as 10 percent of the lower part of the subsoil.

Included with this soil in mapping are small areas of Symco soils, which make up about 10 percent of this map unit. Symco soils are somewhat poorly drained and are in drainageways in slightly higher positions on the landscape than the Brookston soil.

Permeability is moderate or moderately slow, and the available water capacity is high. Surface runoff is slow. The surface layer is friable and easily tilled, except during wet periods. The shrink-swell potential is moderate. The subsoil is mildly alkaline. Free lime is present in the substratum. The organic matter content is high, and natural fertility is medium. This soil is saturated to a depth of less than 1 foot during wet periods. When the soil is saturated, plant roots are restricted.

Some areas of this soil are farmed, and others are used for pasture or as woodland. If it is drained, this soil has fair potential for cultivated crops. It has fair potential for trees and poor potential for building site development and sanitary facilities.

If this soil is drained it is suited to corn. Small grains often lodge because of the high content of organic matter. Legumes are subject to winterkill from ponding and ice sheeting. Some areas are susceptible to frost late in spring and early in fall, thus the growing season is shorter in those areas.

If this soil is used as pasture, overgrazing or grazing when the soil is wet can cause surface compaction, ponding, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition. For highest pasture yields, artificial drainage is needed.

This soil is suited to trees; some areas remain in native hardwoods. Plant competition and equipment limitations are severe and the rate of seedling mortality is high because of wetness and frequent flooding. Trees growing on this soil are shallow rooted, and windthrow is a moderate hazard. Clear cutting or area-selection harvesting can overcome this hazard. Harvesting operations should be carried out in winter to increase mobility and decrease damage to the soil. Spraying or scalping an area where seedlings are planted helps to control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development because of wetness and frequent flooding. Buildings can be constructed on this soil if the soil is adequately drained and protected from flooding. Because local roads and streets are subject to damage from frost heave and flooding, a large amount of roadfill is needed. Septic tank absorption fields do not work well on this soil because of frequent flooding and wetness.

Capability subclass IIw; woodland suitability subclass 4w.

CnB—Channahon loam, 2 to 6 percent slopes. This soil is gently sloping, shallow, and well drained. It is on uplands. The areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 10 inches thick; the upper part is dark brown, friable clay loam, and the lower part is light brown, friable clay loam. The substratum, at a depth of about 18 inches, is white dolomite. In some places the surface layer is eroded.

Included with this soil in mapping, and making up 5 to 10 percent of this map unit, are small areas of Hochheim and Whalan soils, areas where the soil is less than 10 inches thick over dolomite, and areas that have many surface stones and dolomite outcrops. Hochheim and Whalan soils are well drained.

Permeability is moderate, and the available water capacity is low. Runoff is medium. The surface layer is friable and can be easily tilled, except where stones and outcrops hinder cultivation. The shrink-swell potential is moderate in the subsoil. Plant roots are restricted by dolomite at a depth of about 18 inches. The subsoil is mildly alkaline. The organic matter content is moderate, and natural fertility is low.

Many areas of this soil are farmed. This soil has fair potential for cultivated crops, small grains, hay, pasture, and trees. It has poor potential for most building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. Crop yields are limited in most seasons by the low available water capacity. Tillage is difficult in some areas of this soil which have many dolomite fragments and outcrops. There is a slight hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas slopes are long enough and uniform enough for contour tillage. Maintaining the organic matter content helps prevent erosion and increase the available water capacity. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees. The low available water capacity of this soil reduces tree growth. Dolomite fragments and outcrops are a hazard in machine planting; hand planting may be necessary in some areas. Seedlings survive well. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development and sanitary facilities because of dolomite at a depth of less than 20 inches. Buildings with foundations in the dolomite are very stable. The effluent from septic tank absorption fields moves rapidly through the cracks in the dolomite to the ground water supply.

Capability subclass IIIe; woodland suitability subclass 3d.

CnC—Channahon loam, 6 to 12 percent slopes. This soil is sloping, shallow, and well drained. It is on uplands. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 4 inches thick. The subsurface layer is dark brown loam about 3 inches thick. The subsoil is about 8 inches thick; the upper part is dark brown, friable clay loam, and the lower part is light brown, friable clay loam. The substratum, at a depth of about 15 inches, is white dolomite.

Included with this soil in mapping are small areas of Hochheim and Whalan soils, areas of Channahon soils that have slopes of as much as 18 percent, and areas where the soil is less than 10 inches thick over dolomite. These areas make up 5 to 15 percent of this map unit. Hochheim soils are well drained and are in a position on the landscape similar to that of the Channahon soil. Whalan soils are well drained and are in a more level position on the landscape on the top of hills.

Permeability is moderate. The available water capacity generally is low and in some areas is very low. Runoff is medium or rapid. The surface layer is friable and easily tilled. Tillage by machine is impractical in many areas that have dolomite fragments and outcrops. The shrink-swell potential is moderate in the subsoil. Plant roots are restricted by the dolomite at a depth of about 15 inches. The subsoil is mildly alkaline. The organic matter content is moderate, and natural fertility is low.

Most areas of this soil are used for pasture or woodland. This soil has fair potential for hay, pasture, and trees. It has poor potential for row crops and for building site development and sanitary facilities.

This soil is poorly suited to row crops and small grains. Because of a moderate hazard of erosion and machine tillage hazards, this soil is generally not productive and is impractical for row crops and small grains.

Using this soil for hay or pasture is effective in controlling erosion. The low or very low available water capacity reduces yields. Overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees. The low or very low available water capacity of this soil reduces tree growth. Dolomite fragments and outcrops are a hazard in machine planting. Hand planting is necessary in most areas. Seedlings survive well. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development because of slope and dolomite at a depth of less than 20 inches. If the soil is leveled, some of the dolomite may need to be removed. Buildings with foundations on dolomite are very stable. The effluent from septic tank absorption fields moves rapidly through the fractured dolomite to the ground water supply.

Capability subclass IVe; woodland suitability subclass 3d.

CoA—Cosad loamy fine sand, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes in drainageways on glacial lake and till plains. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark yellowish brown and brown, mottled, very friable loamy sand and sand, and the lower part is reddish brown, mottled, firm silty clay. The substratum to a depth of 60 inches is reddish brown, mottled silty clay. In some small areas the upper part of the subsoil has as much as 20 percent gravel.

Included with this soil in mapping are small areas of Tedrow, Tustin, and Wauseon soils, which make up 5 to 15 percent of this map unit. Tedrow soils are somewhat poorly drained and are in a position on the landscape similar to that of the Cosad soil. Tustin soils are well drained and are in slightly higher positions on the landscape. Wauseon soils are poorly drained and are in slightly lower positions on the landscape.

Permeability is rapid in the surface layer and subsoil and slow in the substratum. The available water capacity is low. Runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is very low in the surface layer and subsoil and moderate in the substratum. Plant roots are restricted by saturated soil conditions to a depth of less than 3 feet during wet periods. Reaction is neutral. Free lime is in the substratum. The organic matter content and natural fertility are low. This soil is saturated to a depth of 1 to 3 feet in wet periods. Water may collect on lower slopes following heavy rains.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, small grains, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn, small grains, grasses and legumes, and hay. Legumes are subject to winterkill from water that collects on lower slopes. Harvesting of crops is difficult during wet periods. Surface and subsurface drainage systems help overcome these water-related problems. Plant growth is also restricted during dry periods by the low available water capacity of this soil.

Overgrazing can damage vegetation and subject this soil to soil blowing. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition. Yields from pasture plants are low because of the low available water capacity.

This soil is poorly suited to use as woodland because of moderate limitations for equipment operations, seedling mortality, the windthrow hazard, and plant competition. Harvesting operations should be done when the ground is frozen. Clear cutting or area-selection harvesting can overcome the windthrow hazard. Scalping or spraying the existing vegetation can control plant competition.

This soil is poorly suited to building site development and septic tank absorption fields. Because local roads and streets are subject to wetness and frost heave, a drainage system is needed. Side walls of excavations flow when wet and slough when dry. Footings and basements are subject to wetness and may crack because of the low strength of this soil. Footings should be designed to prevent damage to them by the shrinking and swelling of the substratum. A drainage system installed around the footings can help overcome wetness, low strength, and shrinking and swelling. Septic tank absorption fields are subject to failure because of the excessive wetness of the soil.

Capability subclass IIIw; woodland suitability subclass 4w.

DoB—Dodge silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on drumlins and ground moraines. The areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsoil is about 31 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, friable silt loam; the middle part is dark yellowish brown, friable silty clay loam; and the lower part is dark yellowish brown, friable clay loam and sandy clay loam. The substratum to a depth of 60 inches is light yellowish brown, very friable loam. Some small areas of this soil have slopes of less than 2 percent and other small areas have slopes of as much as 8 percent. In some small areas 3 to 4 inches of the surface layer has been lost because of erosion.

Included with this soil in mapping are small areas of Mayville soils, which make up 5 to 10 percent of this map unit. Mayville soils are moderately well drained and are in slightly lower, concave positions on the landscape.

Permeability is moderate, and the available water capacity is high. Runoff is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is neutral. Free lime is in the substratum. The organic matter content is moderate or moderately low, and natural fertility is medium. Water can collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has good to poor potential for building site development and sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay and pasture. If this soil is used for cultivated crops, erosion is a slight hazard. Minimum tillage, winter cover crops, contour strips, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and the infiltration rate.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to building site development because of the moderate shrink-swell potential and low strength. Using oversized steel-reinforced concrete footings and backfilling with sand and gravel can help overcome these limitations. Because local roads and streets are subject to damage from high frost action and low strength, a thick layer of suitable roadfill is needed over the subsoil. This soil is suited to use as septic tank absorption fields.

Capability subclass IIe; woodland suitability subclass 2o.

Du—Dune land. This miscellaneous area is gently sloping and sloping and excessively drained. It is on old beaches. The areas are irregular in shape and range from 10 to 100 acres in size. Slopes range from 2 to 12 percent.

Dune land consists of ridges and troughs of fine sand that does not have genetic soil horizons and that has hardly any vegetation.

Included with this soil in mapping are small areas of Oakville soils, which make up about 5 percent of this map unit. Oakville soils are well drained and are in stabilized areas.

Permeability is rapid, and the available water capacity is low. Runoff is slow. The shrink-swell potential is low. Reaction ranges from slightly acid to mildly alkaline. The organic matter content and natural fertility are low.

Most areas of Dune land are idle. They are not productive of crops, pasture plants, or trees. Onsite investigation is needed to determine the potential for new land use.

Dune land has not been stabilized by vegetation and is subject to soil blowing. The hazard of soil blowing, low fertility, and the low available water capacity make this unit unproductive of all types of vegetation. Management practices that control soil blowing, increase fertility, and establish a vegetative cover are needed.

Dune land is suited to use as building sites in areas where slopes are less than 8 percent. The steeper slopes need leveling. Cutbanks of shallow excavations may cave in. Establishment and maintenance of lawns and landscape plantings are difficult. Ground water supplies are subject to pollution from sewage effluent because of the rapid permeability.

Capability subclass VIIIs; not assigned to a woodland suitability subclass.

Fu—Fluvaquents. These soils are nearly level and poorly drained. They are on flood plains that are dissected by watercourses and that are subject to frequent flooding (fig. 6). The areas are long and narrow and range from 10 to 200 acres in size. Slopes range from 0 to 2 percent.

These soils consist of sediments recently deposited by floodwaters. They range from sand to silt loam and include thin layers of organic material. These soils are too variable to classify except at the suborder level.

Included with these soils in mapping are small areas of Bellevue and Palms soils, which make up 5 to 15 percent of this map unit. Bellevue soils are moderately well drained; they formed in loamy material and are in slightly higher positions on the landscape than the Fluvaquents. Palms soils are very poorly drained and are in depressions.

These soils have variable soil properties. They have a water table at a depth of less than 1 foot during most of the year.

Most areas of these soils are used for pasture or as woodland. These soils have poor potential for cultivated crops, hay, pasture, and trees. They also have poor potential for building site development.

Figure 6.—An area of Fluvaquents that is subject to flooding. The river channel is in the upper part of the picture.

These soils are poorly suited to crops, unless they are protected from flooding and are artificially drained. They have good potential for specialty crops if they are drained and protected from flooding.

These soils are poorly suited to pasture. Grazing should be restricted to dry periods, but the dry periods are too short for the soils to be used economically for pasture.

These soils are poorly suited to woodland use because of wetness and flooding. Harvesting operations are restricted to winter, when the ground is frozen. Planting on ridges generally is done by hand. Spraying or scalping the existing vegetation can control plant competition. Clearcutting or area-selection harvesting can control the windthrow hazard. Older trees that tolerate wetness grow rapidly.

These soils are poorly suited to building site development and sanitary facilities because of wetness and frequent flooding.

Capability subclass Vw; not assigned to a woodland suitability subclass.

Gb—Granby fine sandy loam. This soil is nearly level and poorly drained. It is in broad depressions and drainageways on outwash plains and old beaches. It is subject to frequent flooding. The areas are irregular in shape and range from 5 to 500 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is black fine sandy loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part of the subsoil is brown, mottled, friable loamy fine sand, and the lower part is light yellowish brown, mottled, loose fine sand. The substratum to a depth of 60 inches is brown, mottled, loose fine sand. In some small areas the substratum is as much as 20 percent coarse fragments. In other small areas the surface layer is as much as 12 inches of muck.

Included with this soil in mapping are small areas of Adrian and Tedrow soils, which make up 5 to 10 percent of this map unit. Adrian soils are very poorly drained and are in slightly lower positions on the landscape than the Granby soil. Tedrow soils are somewhat poorly drained and are in slightly higher positions on the landscape.

Permeability is rapid, and the available water capacity is low. Runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is low. Root growth is restricted for most plants by saturated soil conditions. The subsoil and substratum are mildly alkaline. The organic matter content is high, and natural fertility is low. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil are used as pasture or woodland. This soil has poor potential for cultivated crops, hay, pasture, and building site development.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay and pasture. Yields from these crops are low because of the low available water capacity and wetness. Legumes are subject to winterkill from ponding and ice sheeting. This soil has potential for specialty crops if it is drained and irrigated. Drainage is needed in wet periods, and irrigation is needed in dry periods. Controlled drainage helps prevent extreme wetness and dryness on this soil.

This soil is poorly suited to pasture. Native plants have low food value, and yields are low. Drainage and renovation are needed to produce an acceptable pasture.

This soil is poorly suited to woodland use. Limitations for the use of equipment are severe. Seedling mortality and plant competition are severe hazards. Harvesting should be done in winter when the ground is frozen. Hand planting is needed in wet periods. Trees on this soil are shallow rooted and subject to windthrow. Clear cutting or area selection harvesting can overcome this hazard. Seedlings do not survive well because of frequent flooding and saturated soil. Scalping or spraying the existing vegetation can control plant competition.

This soil is poorly suited to building site development. Excavation cutbanks can cave in. Buildings can be damaged by wetness if this soil is not drained and protected from flooding. Because local roads and streets are subject to damage from frequent flooding, a large amount of roadfill is needed in many places to raise the road surface above flood height. Septic tank absorption fields are subject to failure because of wetness and frequent flooding.

Capability subclass IIIw; woodland suitability subclass 3w.

HmB—Hochheim loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on slightly convex tops of drumlins and on ground moraines. The areas are irregular in shape and range from 10 to 600 acres in size.

Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is dark yellowish brown, friable loam; the middle part is dark brown, friable clay loam; and the lower part is dark yellowish brown, friable loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam. In some areas of this soil the subsoil is thinner and shallower to free carbonates. In some small areas this soil is eroded.

Included with this soil in mapping are small areas of Boyer and Symco soils, which make up 5 to 15 percent of this map unit. Boyer soils are well drained and are in similar positions on the landscape as the Hochheim soil. Symco soils are somewhat poorly drained and are in shallow depressions and drainageways. Also included are areas of Hochheim soil where gravel and cobblestones make up as much as 20 percent of the surface layer and subsoil. In other small areas the Hochheim soil has mottles in the substratum, indicating the presence of a water table at a depth of less than 5 feet during wet periods.

Permeability is moderate or moderately slow, and the available water capacity is moderate. Surface runoff is medium. The surface layer is easily tilled. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is present in the substratum. The organic matter content is moderate, and natural fertility is medium where the soil is not eroded. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has good potential for building site development and fair potential for sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay and pasture. If it is used for cultivated crops, there is a slight hazard of erosion. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and water infiltration.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is suited to building site development. It is moderately limited for use as sites for local roads and streets because of frost action and low strength. Placing a layer of suitable roadfill on the subsoil can overcome these limitations. The restricted permeability is a limitation in using this soil as a septic tank absorption field in some areas. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIe; woodland suitability subclass 2o.

HmC2—Hochheim loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on convex side slopes on drumlins and ground moraines. The areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is about 12 inches thick. It is brown or dark yellowish brown, friable clay loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam. In some small areas this soil is not eroded.

Included with this soil in mapping are small areas of Boyer and Symco soils, areas of Hochheim soil that have slopes of more than 12 percent, areas of severely eroded Hochheim soil, and areas of Hochheim soil where gravel and cobblestones make up as much as 20 percent of the surface layer and subsoil. These included areas make up 5 to 15 percent of this map unit. Boyer soils are well drained and are in a position on the landscape similar to that of the Hochheim soil. Boyer soils, however, have a substratum of sand and gravel. Symco soils are somewhat poorly drained and are in drainageways. In small, severely eroded areas on side slopes of crests, the Hochheim soil has a surface layer of clay loam.

Permeability is moderate or moderately slow, and the available water capacity is moderate. Surface runoff is rapid. The surface layer is friable, and the soil can be easily tilled, except where all of the surface layer has been lost by erosion. In some areas, tilth is restricted by excessive stoniness. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is present in the substratum. The organic matter content is moderate, and natural fertility is low.

Most areas of this soil are farmed. This soil has good potential for hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is best suited to small grains and legumes for hay and pasture. If this soil is used for row crops, the hazard of erosion is moderate. Minimum tillage, contour tillage, winter cover crops, grassed waterways, and long rotations that include a year of corn help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and water infiltration.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to building site development because of slope, low strength, and frost action. Considerable excavation is necessary to prepare a building site. Foundations should be constructed of steel-reinforced concrete and backfilled with sand to offset the low strength of the soil. Because local roads and streets are subject to damage from frost action and low strength, placing a layer of suitable roadfill on the subsoil is needed. Septic tank absorption fields should be placed on the contour to prevent the effluent from surfacing.

Capability subclass IIIe; woodland suitability subclass 2o.

HmD2—Hochheim loam, 12 to 20 percent slopes, eroded. This soil is moderately steep and well drained. It is on the sides of drumlins and on ground moraines. The areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is yellowish brown and brown clay loam about 10 inches thick. The substratum to a depth of 60 inches is light yellowish brown gravelly loam. In some small areas of this soil the subsoil is thinner and shallower to free carbonates. In other small areas the soil is not eroded.

Included with this soil in mapping are small areas of Boyer and Lutzke soils, areas of Hochheim soils that are severely eroded, and areas of Hochheim soils that have slopes of more than 20 percent. These areas make up 5 to 15 percent of this map unit. Boyer and Lutzke soils are well drained and are in similar positions on the landscape.

Permeability is moderate or moderately slow, and the available water capacity is moderate. Runoff is rapid. This soil is difficult to till because of slope and because in some areas the subsoil is exposed. The surface layer is subject to crusting after rains. The crusting makes emergence of small seeded plants difficult. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is low.

Most areas of this soil are farmed. This soil has poor potential for row crops and fair potential for hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is suited to grasses and legumes for pasture and hay. Because the subsoil is exposed in places, this soil is more difficult to till than uneroded soils. If this soil is used for row crops, erosion is a severe hazard. Contour tillage, minimum tillage, winter cover crops, surface runoff diversions, and long rotations that include a year of row crops are needed to prevent excessive soil loss.

Using this soil for pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. Roads used for planting and harvesting operations should be on the contour to prevent excessive erosion. Slope restricts equipment use, and hand planting may be necessary in some places. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Tree growth is better on the north-facing and east-facing slopes than on the hotter and drier south-facing and west-facing slopes.

This soil is poorly suited to building site development and sanitary facilities because of slope. Extensive leveling is needed. Some areas of this soil include gently sloping hilltops, which are large enough for a single dwelling.

Capability subclass IVe; woodland suitability subclass 2r.

HnB—Hochheim-Nichols-Boyer complex, 2 to 6 percent slopes. This complex consists of gently sloping soils on undulating moraines. The areas are irregular in shape and range from 10 to 100 acres in size. The soils are well drained.

This map unit consists of about 35 percent Hochheim loam, 30 percent Nichols very fine sandy loam, 20 percent Boyer sandy loam, and 15 percent minor soils. The Hochheim soil is mainly on the side slopes of ridges and hills. The Nichols soil and the Boyer soil are mainly on the top of hills and ridges. These soils are so intricately mixed and areas are so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hochheim soil is dark brown loam about 7 inches thick. The subsoil is about 14 inches thick. In the upper part it is dark yellowish brown, friable loam; in the middle part it is dark brown, friable clay loam; and in the lower part it is dark yellowish brown, friable loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam.

Typically, the surface layer of the Nichols soil is dark brown very fine sandy loam about 8 inches thick. The subsoil is about 15 inches thick. In the upper part it is pale brown, friable very fine sandy loam, and in the lower part it is light brown, friable very fine sandy loam. The substratum to a depth of 60 inches is very pale brown, friable very fine sand.

Typically, the surface layer of the Boyer soil is very dark grayish brown sandy loam about 6 inches thick. The subsurface layer is pale brown sandy loam about 3 inches thick. The subsoil is about 20 inches thick. In the upper part it is dark yellowish brown, friable sandy loam; in the middle part it is brown, friable gravelly sandy clay loam; and in the lower part it is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel.

Included with these soils in mapping are small areas of Palms and Lutzke soils, which make up about 15 percent of the complex. Palms soils are very poorly drained organic soils in depressions and on bottoms of glacial lake basins. Lutzke soils are well drained and are on slightly steeper positions on the landscape than the Boyer soil.

Permeability is moderate or moderately slow in the Hochheim soil, moderate in the Nichols soil, and moderately rapid to very rapid in the Boyer soil. The available water capacity is high in the Nichols soil, moderate in the Hochheim soil, and low in the Boyer soil. Surface runoff is slow to medium. The surface layer of these soils is friable and easily tilled. The shrink-swell potential is low or moderate. In the Boyer soil, root growth is restricted for some crops by the sand and gravel in the substratum. The subsoil of these soils is neutral to mildly alkaline. Free lime is present in the substratum. The organic matter content is low to moderate, and natural fertility is low or medium.

Most areas of these soils are farmed. The soils have fair to good potential for cultivated crops, hay, pasture, and trees. They have good potential for building site development. Onsite investigation is needed to determine the suitability of the soil for a specific use.

These soils are well suited to corn, small grain, and grasses and legumes for hay and pasture. If these soils are used for cultivated crops, there is a slight hazard of erosion. Yields are reduced on the Boyer soil in an extended dry period. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps improve fertility and the available water capacity.

Using these soils for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soils are wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soils in good condition.

These soils are suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

Hochheim and Nichols soils are only fairly suited to use as local roads and streets because of the frost action potential and low strength in the subsoil. The Boyer soil has suitable base material in the substratum. The soils in this complex are suited to use as building sites and as septic tank absorption fields. The restricted permeability in the Hochheim soil and the danger of ground water pollution on the Boyer soil are hazards in using these soils as septic tank absorption fields.

Capability subclass IIe; woodland suitability subclass: Hochheim-2o, Nichols-1o, Boyer-3o.

HnC2—Hochheim-Nichols-Boyer complex, 6 to 12 percent slopes, eroded. This complex consists of sloping soils on rolling moraines. The areas are irregular in shape and range from 10 to 100 acres in size. The soils are well drained.

This complex consists of about 35 percent Hochheim loam, 25 percent Nichols very fine sandy loam, 25 percent Boyer sandy loam, and 15 percent minor soils. The Hochheim soil is mainly on the side slopes of ridges and hills. The Nichols soil and the Boyer soil are mainly on the top of hills and ridges. These soils are so intricately mixed and the areas are so small in size that it was not practical to separate them in mapping.

Typically, the surface layer of the Hochheim soil is dark brown loam about 6 inches thick. The subsoil is about 12 inches thick. It is brown or dark yellowish brown, friable clay loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam.

Typically, the surface layer of the Nichols soil is dark brown very fine sandy loam about 6 inches thick. The subsoil is about 13 inches thick. It is pale brown, friable very fine sandy loam in the upper part and light brown, friable very fine sand in the lower part. The substratum to a depth of 60 inches is pale brown very fine sand.

Typically, the surface layer of the Boyer soil is brown sandy loam about 6 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown, friable sandy loam in the upper part; brown, friable gravelly sandy clay loam in the middle part; and brown, friable gravelly sandy loam in the lower part. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel.

Included with these soils in mapping are small areas of Palms and Lutzke soils, which make up about 15 percent of the complex. Palms soils are very poorly drained organic soils that are in depressions and on bottoms of glacial lake basins. Lutzke soils are well drained and are in slightly steeper positions on the landscape than the Boyer soil. Also included are small areas where the major soils are severely eroded. In some places the included soils have stones on the surface.

Permeability is moderate or moderately slow in the Hochheim soil and moderate in the Nichols soil. In the Boyer soil, permeability is moderately rapid in the upper part and very rapid in the lower part. The available water capacity is high in the Nichols soil, moderate in the Hochheim soil, and low in the Boyer soil. Surface runoff is moderate to rapid. The surface layer is difficult to till because some of the more clayey subsoil is mixed in the plowed layer. In some places tilth is poor because of surface stones. Because the soils in this map unit are subject to puddling and crusting after rains, growth of small-seeded plants is difficult. The shrink-swell potential is low or moderate. In the Boyer soil, root growth is restricted for some crops by the sand and gravel in the substratum. The upper part of the subsoil is neutral to mildly alkaline, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is low to moderate, and natural fertility is low.

Most areas of these soils are farmed. The soils have fair to good potential for cultivated crops, hay, pasture, and trees. They have fair potential for building site development. Sites should be investigated to determine the type of soil at a given location before planning changes in land use.

These soils are suited to small grain, grasses, and legumes. Because some of the subsoil is exposed, these soils are more difficult to till than uneroded soils. If the soils are used for row crops such as corn, erosion can remove large amounts of the surface layer. Water erosion is a moderate hazard, and the soils are stony in some places. Minimum tillage, winter cover crops, contour tillage, grassed waterways, and long rotations including a year of row crops help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and the infiltration rate.

Using these soils for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

These soils are well suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

These soils are fairly suited to use as building sites, local roads and streets, and septic tank absorption fields. Considerable excavation is necessary to prepare a site. The Boyer soil is difficult to revegetate after excavation. The restricted permeability in the Hochheim soil and the danger of ground water pollution on the Boyer soil are hazards in using these soils as septic tank absorption fields.

Capability subclass IIIe; woodland suitability subclass: Hochheim-2o, Nichols-1o, Boyer-3o.

HnD—Hochheim-Boyer-Nichols complex, 12 to 25 percent slopes. This complex consists of moderately steep and steep soils on short, complex side slopes of ground moraines. The areas are irregular in shape and range from 5 to 80 acres in size. The soils are well drained.

This map unit consists of about 35 percent Hochheim loam, 30 percent Boyer sandy loam, 20 percent Nichols very fine sandy loam, and 15 percent minor soils. The Hochheim soil is mostly on the side slopes of ridges and hills. The Boyer soil is mostly on the convex tops of hills and ridges. The Nichols soil is mostly on the slightly concave top and lower slopes of hills and ridges.

Typically, the surface layer of the Hochheim soil is very dark brown loam about 3 inches thick. The subsurface layer is pale brown loam about 3 inches thick. The subsoil is about 11 inches thick. It is yellowish brown and brown, friable clay loam. The substratum to a depth of 60 inches is light yellowish brown, friable gravelly loam.

Typically, the surface layer of the Boyer soil is very dark brown sandy loam about 3 inches thick. The subsurface layer is pale brown sandy loam about 3 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown, friable sandy loam in the upper part; brown, friable loam in the middle part; and brown, friable gravelly sandy loam in the lower part. The substratum to a depth of 60 inches is yellowish brown, loose sand and gravel.

Typically, the surface layer of the Nichols soil is very dark grayish brown very fine sandy loam about 3 inches thick. The subsurface layer is grayish brown very fine sandy loam about 3 inches thick. The subsoil is about 12 inches thick. It is pale brown very fine sandy loam. The substratum to a depth of 60 inches is pale brown very fine sand.

Included with these soils in mapping are small areas of Palms and Lutzke soils, which make up about 15 percent of the complex. Also included are small areas where slopes range to 40 percent and other areas where slopes are less than 12 percent. Palms soils are very poorly drained organic soils that are in depressions and glacial kettles. Lutzke soils are well drained and are in slightly higher positions on the landscape than the Boyer soil. In some small areas the soils in this complex are stony.

Permeability is moderate or moderately slow in the Hochheim soil, moderate in the Nichols soil. In the Boyer soil, it is moderately rapid in the subsoil and very rapid in the substratum. Surface runoff is very rapid. These soils are difficult to till because of slope and stoniness. The shrink-swell potential is low or moderate. In the Boyer soil, root growth is restricted for some crops by sand and gravel in the substratum. The subsoil is neutral to mildly alkaline. Free lime is in the substratum. The organic matter content and natural fertility are low.

Most areas of these soils are used as pasture or woodland. The soils have poor potential for cultivated crops and building site development.

These soils are well suited to grasses and legumes for pasture. There is a severe hazard of erosion, and these soils are difficult to till.

Using these soils for pasture is effective in controlling erosion. Overgrazing or grazing when the soils are wet can cause surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

These soils are suited to trees; a few small areas remain in native hardwoods. Roads used for planting and harvesting operations should be on the contour to prevent excessive erosion. Slope restricts equipment use, and hand planting may be necessary in some places. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

These soils are poorly suited to building site development and sanitary facilities because of slope. Leveling operations to prepare building sites generally are not feasible. Some of the less sloping areas are large enough for a single dwelling.

Capability subclass IVe; woodland suitability subclass: Hochheim-2r, Boyer-3o, Nichols-1r.

HrB—Hortonville silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes on till plains. The areas are irregular in shape and range from 10 to 600 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark brown and brown, friable loam; the middle part is reddish brown, friable clay loam; and the lower part is reddish brown, friable loam. The substratum to a depth of 60 inches is reddish brown, friable loam.

Included with this soil in mapping are small areas of Kewaunee, Symco, and Waymor soils, which make up 5 to 15 percent of this map unit. Kewaunee and Waymor soils are in positions on the landscape similar to that of the Hortonville soil. Symco soils are somewhat poorly drained and are in drainageways and broad concave areas. Also included are small areas of soils that are moderately well drained and have mottles at a depth of 3 to 5 feet.

Permeability is moderately slow, and the available water capacity is high. Runoff is medium. The surface layer is easily tilled. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is low, and the natural fertility is medium. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay and pasture. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, and grassed waterways help prevent soil loss. Returning crop residue to the soil or adding other organic material helps improve fertility and the infiltration rate.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to use as sites for dwellings and septic tank absorption fields because of low strength and moderately slow permeability. Using steel-reinforced concrete and oversizing the bottom of the footings can help overcome low strength. Installing oversized absorption fields can help compensate for the moderately slow permeability. This soil is poorly suited to local roads and streets because of low strength. Installing a thick layer of suitable roadfill can help overcome this limitation.

Capability subclass IIe; woodland suitability subclass 2o.

HrC2—Hortonville silt loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on side slopes on till plains and moraines. The areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown silt loam about 7 inches thick. The subsoil is 16 inches thick. The upper part of the subsoil is dark brown and brown, friable loam; the middle part is reddish brown, friable clay loam; and the lower part is reddish brown, friable loam. The substratum to a depth of 60 inches is reddish brown, friable loam. In some small areas this soil is not eroded. In other small areas it has slopes of more than 12 percent.

Included with this soil in mapping are small areas of Kewaunee and Waymor soils and small areas of severely eroded Hortonville soils, which make up 5 to 10 percent of this map unit. Kewaunee and Waymor soils are in positions on the landscape similar to those of the Hortonville soil. The severely eroded Hortonville soils are on convex side slopes and hilltops.

Permeability is moderately slow, and the available water capacity is high. Runoff is rapid. This soil is difficult to till because the subsoil is exposed in places. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Because some of the subsoil is exposed, this soil is more difficult to till than uneroded soils. Erosion is a moderate hazard. Minimum tillage, contour tillage, winter cover crops, grassed waterways, and long rotations that include a year of corn help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps improve fertility and increase the infiltration rate.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to use as building sites. Considerable excavation is necessary to prepare a site. Because local roads and streets are subject to damage by the shrinking and swelling and low strength of the subsoil, suitable roadfill is needed over the subsoil. This soil is only fairly suited to use as septic tank absorption fields because of the moderately slow permeability and slope. Installing oversized absorption fields can help overcome these limitations.

Capability subclass IIIe; woodland suitability subclass 2o.

HrD2—Hortonville silt loam, 12 to 20 percent slopes, eroded. This soil is moderately steep and well drained. It is on side slopes on till plains and moraines. The areas are long and narrow and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is brown and yellowish brown, friable loam; the middle part is reddish brown, friable clay loam; and the lower part is reddish brown, friable loam. The substratum to a depth of 60 inches is reddish brown, friable loam. In some small areas of this soil, slopes are less than 12 percent or more than 20 percent. In other small areas the soil is not eroded.

Included with this soil in mapping are small areas of Kewaunee and Waymor soils, which make up 5 to 10 percent of this map unit. Kewaunee soils are in a position on the landscape similar to that of the Hortonville soil. Waymor soils occupy similar topography. Also included are small areas of Hortonville soils in which all of the surface layer was lost by erosion.

Permeability is moderately slow, and the available water capacity is high. Runoff is rapid. This soil is difficult to till because of slope and poor tilth. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has poor potential for cultivated crops and fair potential for pasture and woodland. It has poor potential for building site development and sanitary facilities.

Erosion is a severe hazard in cultivated areas. Because some of the subsoil is exposed, this soil is more difficult to till than uneroded soils. This soil is suited to grasses and legumes for pasture and hay.

Using this soil for pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction and excessive runoff. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. Roads used for planting and harvesting operations should be on the contour to prevent excessive erosion. Slope restricts equipment use, and hand planting may be necessary in some places. Seedlings survive well. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is limited for most types of building site development by slope. Extensive leveling is needed. Some small areas of gently sloping soils on ridgetops are large enough for a single dwelling.

Capability subclass IVe; woodland suitability subclass 1r.

Hu—Houghton muck. This soil is nearly level and very poorly drained. It is in depressions in old glacial lakes and is subject to frequent flooding. The areas are irregular in shape and range from 5 to 1,000 acres in size. Slopes range from 0 to 2 percent.

Typically, the organic layer is black and dark yellowish brown muck to a depth of about 60 inches. In some small areas this soil is as much as 10 percent woody fragments.

Included with this soil in mapping are small areas of Adrian, Palms, and Willette soils, which make up 5 to 10 percent of this map unit. All of these included soils are in positions on the landscape similar to that of the Houghton soil but are underlain by mineral soil at a depth of 16 to 51 inches. Also included are small areas of soils that have marl or sedimentary peat below a depth of 20 inches. Some small areas of open water are also included.

Permeability is moderately rapid, and the available water capacity is very high. Runoff is slow. Root growth is restricted in this soil by saturated soil conditions. The surface layer is slightly acid, and the second and third layers are medium acid. The organic matter content is very high, and natural fertility is low. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil remain in native vegetation. This soil has poor potential for cultivated crops and building site development.

This soil is poorly suited to use as cropland. A short growing season, caused by frost late in spring and early in fall, limits the type of crops that can be grown. Most areas also do not have suitable outlets for surface and subsurface drainage systems. Specialized equipment is needed to cultivate this soil. Areas that are artificially drained and used as cropland are subject to soil blowing and subsidence. If this soil is drained, mint and other specialty crops can be grown.

Artificially drained areas can be used for pasture; however, yields are low. The surface layer of muck has poor trafficability, and use is restricted to dry periods.

This soil is poorly suited to woodland use. It has severe limitations for equipment operation. Seedling mortality and plant competition are severe hazards. Harvesting operations are restricted to winter, when the ground is frozen. Planting generally is done by hand. Trees on this soil are shallow rooted, and windthrow is a hazard. Flooding is frequent, and seedling survival is difficult because of the saturated soil conditions. Scalping or spraying before planting can control plant competition.

This soil is poorly suited to building site development because of flooding and the wetness and low strength of this soil. Local roads and streets are subject to damage from wetness, frost heave, and subsidence; therefore, the organic material should be replaced by coarse-textured base material. A drainage system is needed to remove excess water from the road area. This soil is poorly suited to use as septic tank absorption fields because of flooding and wetness.

Capability subclass IVw; woodland suitability subclass 3w.

Ke—Keowns very fine sandy loam. This soil is nearly level and poorly drained. It is in depressions in glacial lake basins and is subject to frequent flooding. The areas are irregular in shape and range from 5 to 100 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is very dark gray very fine sandy loam about 13 inches thick. The subsoil is 16 inches thick. The upper part of the subsoil is pale brown, friable very fine sandy loam, and the lower part is brown, mottled, friable very fine sandy loam. The upper part of the substratum, to a depth of 54 inches, is brown and grayish brown, mottled very fine sandy loam. The lower part, to a depth of 60 inches, is light yellowish brown fine and medium sand. In some small areas of this soil the surface layer is as much as 6 inches of muck, and in other areas the surface layer does not have free carbonates. In some small areas the substratum is as much as 20 percent coarse fragments.

Included with this soil in mapping are small areas of Granby, Palms, and Pella soils, which make up 5 to 15 percent of this map unit. Palms soils are very poorly drained and formed in 16 to 51 inches of organic material. They are in wet depressions. Granby and Pella soils are poorly drained and are in positions on the landscape similar to that of the Keowns soil.

Permeability is moderate, and the available water capacity is high. Runoff is slow. The surface layer is friable and can be easily tilled, except when the soil is wet. Most plant roots are restricted by saturated soil conditions to a depth of less than 1 foot during wet periods. Reaction is mildly alkaline, and free carbonates are throughout the soil. The organic matter content is moderate or high, and natural fertility is medium. This soil is saturated to a depth of less than 1 foot in wet periods.

In most areas this soil is used as pasture or woodland. This soil has fair potential for pasture and trees. It has poor potential for cultivated crops and building site development.

This soil is poorly suited to corn and small grains and legumes for hay. Most areas of this soil do not have a natural outlet for artificial drainage. Many areas were cleared for cropland but are no longer used for cropland because of wet soil conditions and low yields.

This soil is poorly suited to pasture. Overgrazing and grazing when the soil is wet can cause surface compaction and sealing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; many areas remain in native hardwoods. Flooding and wetness are severe equipment limitations. Seedling mortality is a moderate hazard because of flooding and wetness. Plant competition is a severe hazard. Vegetation should be scalped or chemically treated before planting. Trees on this soil are shallow rooted, and windthrow is a hazard. Clear cutting or area selection harvesting can overcome this hazard. Harvesting operations should be carried out during winter to reduce damage to soil and to increase mobility. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development. Because foundations and local roads and streets are subject to damage from flooding and frost heave, suitable roadfill is needed over the subsoil. Septic tank absorption fields are subject to failure because of frequent flooding and saturated soil conditions to a depth of less than 1 foot during wet periods.

Capability subclass IIIw; woodland suitability subclass 1w.

KnB—Kewaunee loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on lower side slopes and convex ridgetops on till plains. The areas are irregular in shape and range from 10 to 600 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 15 inches thick; the upper part of the subsoil is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay. In some small areas of this soil the surface layer is sandy loam or silt loam.

Included with this soil in mapping are small areas of Hortonville, Kolberg, and Manawa soils, which make up 5 to 15 percent of this map unit. Hortonville and Kolberg soils are well drained and are in positions on the landscape similar to that of the Kewaunee soil. Manawa soils are somewhat poorly drained and are in slightly lower positions on the landscape than the Kewaunee soil. Also included are small areas of soils that are moderately well drained. In some small areas the substratum is sand and gravel, and in other small areas of this soil 3 to 5 inches of the surface layer has been lost by erosion.

Permeability is slow, and the available water capacity is moderate. Surface runoff is medium. The surface layer is friable and is easily tilled. In small areas where the upper 3 to 5 inches of the surface layer has been eroded, the soil can be tilled without forming large clods only within a narrow range of moisture content. These small areas of eroded soils are scattered throughout this map unit and control the time of tillage for the entire field. The shrink-swell potential is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium. Water may collect on the lower slopes for short periods after heavy rain.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is well suited to corn and small grain and to grasses and legumes for hay. It is also suited to such specialty crops as peas and green beans for canning. The high reaction of this soil makes it especially well suited to legumes. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, spring tillage, and grassed waterways help prevent excessive soil loss. Many areas have slopes that are long and uniform enough for contour tillage. Terraces and diversions can be used to reduce slope length. Maintaining the content of organic matter in the soil also helps prevent erosion, increase the available water capacity, and improve the infiltration rate. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and the pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly suited to building site development because of the moderate shrink-swell potential and low strength. Constructing foundations with steel-reinforced concrete and backfilling with sand and gravel can help overcome these limitations. Oversizing the bottom of the footings is also helpful. This soil is poorly suited to use as septic tank absorption fields and as sites for local roads and streets. The slow permeability of the substratum is a limitation for septic tank absorption fields. This soil can be used as sites for mound sewage disposal systems. Grading local roads and streets to shed water and placing suitable roadfill on the subsoil can help overcome low strength, the moderate shrink-swell potential, and a moderate frost action potential.

Capability subclass IIe; woodland suitability subclass 2c.

KnC2—Kewaunee loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on the side slopes of moraines and drumlins on till plains. The areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is reddish brown, firm clay about 12 inches thick. The substratum to a depth of 60 inches is reddish brown clay.

Included with this soil in mapping are small areas of Hortonville and Kolberg soils, which make up 5 to 15 percent of this map unit. Hortonville and Kolberg soils are well drained and are in positions on the landscape similar to that of the Kewaunee soil. Also included are small areas of Kewaunee soil that have lost all of the surface layer by erosion.

Permeability is slow, and the available water capacity is moderate. Runoff is medium or rapid. The surface layer is friable but has a narrow range of moisture content in which it can be tilled. If this soil is tilled when the moisture content is too high, large clods will form when the soil dries. This soil is also subject to puddling and crusting. The shrink-swell potential is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. It is also suited to such specialty crops as peas and green beans for canning. The surface layer is subject to crusting, which results in poor emergence of small-seeded crops. If this soil is used for row crops, there is a severe hazard of further damage by erosion. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. In a few areas, slopes are long enough and uniform enough for contour tillage. Diversions can be used to reduce slope length. Maintaining the content of organic matter also helps prevent erosion, increase the infiltration rate, and reduce crusting. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for hay and pasture is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting. Seedlings survive well. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used for planting or harvesting should be on the contour to prevent erosion.

This soil is only fairly suited to building site development because of the moderate shrink-swell potential, low strength, and slope. Constructing foundations with steel-reinforced concrete and backfilling with sand and gravel help offset the shrinking and swelling of the soil. Oversizing the bottom of the footings can help overcome low strength. Extensive leveling can expose the clayey subsoil and substratum, which are difficult to revegetate. This soil is poorly suited to use as septic tank absorption fields and as sites for local roads and streets. The moderately slow permeability of the substratum is a limitation for septic tank absorption fields. This soil can be used as sites for mound sewage disposal systems. Grading local roads and streets to shed water and placing suitable roadfill on the subsoil can overcome low strength, the moderate shrink-swell potential, and a moderate frost action potential.

Capability subclass IIIe; woodland suitability subclass 2c.

KnD2—Kewaunee loam, 12 to 20 percent slopes, eroded. This soil is moderately steep and well drained. It is on the convex side slopes of moraines and drumlins. The areas are long and narrow and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is reddish brown, firm clay about 12 inches thick. The substratum to a depth of 60 inches is reddish brown clay. In some small areas this soil is not eroded.

Included with this soil in mapping are small areas of Hortonville and Kolberg soils, which make up 5 to 15 percent of this map unit. Hortonville and Kolberg soils are well drained and are in positions on the landscape similar to that of the Kewaunee soil. Also included are small areas of the Kewaunee soil where all of the surface layer has been eroded.

Permeability is slow, and the available water capacity is moderate. Runoff is rapid. The surface layer is friable but has a narrow range of moisture content in which it can be tilled. If tilled when the moisture content is too high, it will form large clods upon drying. This soil is also subject to puddling and crusting. The shrink-swell potential is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Many areas of this soil are farmed. This soil has good potential for small grains, hay, pasture, and trees. It has poor potential for row crops. It has poor potential for building site development and sanitary facilities.

This soil is suited to small grains and to grasses and legumes for hay. There is a severe hazard of erosion; therefore, this soil is best suited to close-growing crops. Row crops such as corn allow water erosion to remove large quantities of the surface layer. The surface layer is subject to crusting, which results in poor emergence of small-seeded crops. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. In a few areas the slopes are long enough and uniform enough for contour tillage. Diversions can be used to reduce slope length. Long rotations that include a year of row crops also reduce soil loss. Maintaining the content of organic matter helps prevent erosion, increase the infiltration rate, and reduce crusting. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for hay and pasture is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. Slope is a limiting factor in planting and harvesting operations. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation controls plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used by planting or harvesting equipment should be on the contour to prevent erosion. Some areas may need hand planting.

This soil is poorly suited to use as building sites, local roads and streets, and a septic tank absorption field. These uses require extensive leveling, which leaves only the clayey subsoil or substratum to revegetate. If buildings are constructed on this soil, foundations should be designed to withstand the shrinking and swelling of this soil.

Capability subclass IVe; woodland suitability subclass 2c.

KnE—Kewaunee loam, 20 to 30 percent slopes. This soil is steep and well drained. It is on convex side slopes on moraines and drumlins. The areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 4 inches thick. The subsurface layer is grayish brown loam about 2 inches thick. The subsoil is reddish brown, firm clay about 14 inches thick. The substratum to a depth of 60 inches is reddish brown clay.

Included with this soil in mapping are small areas of Lutzke soils, areas of the Kewaunee soil that have slopes of more than 30 percent, and small areas where all of the surface layer has eroded. These included soils make up 5 to 10 percent of this map unit. Lutzke soils are well drained.

Permeability is slow, and the available water capacity is moderate. Runoff is rapid. The shrink-swell potential is moderate. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are in woodland, and some areas are in pasture. This soil has fair potential for trees or pasture. It has poor potential for cropland, building site development, and sanitary facilities.

This soil is not suited to cultivated crops because of the very severe hazard of erosion.

Using this soil for pasture is effective in controlling erosion. Pasture renovation is very difficult because of the steepness of slope. Grazing when the soil is wet or overgrazing can cause compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is suited to trees; many areas remain in native hardwoods. Slope is a limiting factor in planting and harvesting operations. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation controls plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Careful harvesting prevents erosion. Hand planting is needed in many areas because of slope.

This soil is poorly suited to use as sites for buildings and local roads and streets, and as septic tank absorption fields. Most of these uses require extensive leveling that generally is not practical. If septic tank absorption fields are constructed on this soil, the effluent may surface on the side of the slope.

Capability subclass VIe; woodland suitability subclass 2c.

KpB—Kewaunee-Boyer-Nichols complex, 2 to 6 percent slopes. This complex consists of gently sloping soils on convex side slopes or on moraines. The areas are irregular in shape and range from 5 to 30 acres in size. The soils are well drained.

This unit consists of about 30 percent Kewaunee loam, 20 percent Boyer sandy loam, 15 percent Nichols very fine sandy loam, and 35 percent minor soils.

Typically, the surface layer of the Kewaunee soil is dark brown loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay.

Typically, the surface layer of the Boyer soil is very dark grayish brown sandy loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part of the subsoil is dark yellowish brown sandy loam, the middle part is brown gravelly loam, and the lower part is brown gravelly sandy loam. The substratum to a depth of 60 inches is loose sand and gravel.

Typically, the surface layer of the Nichols soil is dark brown very fine sandy loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is pale brown, friable very fine sandy loam, and the lower part is light brown, friable very fine sandy loam. The substratum to a depth of 60 inches is pale brown very fine sand.

Included with these soils in mapping are small areas of well drained Briggsville, Oakville, and Tustin soils, which make up 35 percent of this map unit. Briggsville soils formed in silty and clayey lacustrine sediment. Oakville soils formed in fine sand. Tustin soils formed in 20 to 40 inches of sandy sediment over clayey deposits. Also included are small areas in which the underlying till and outwash deposits are mixed. In some places the Kewaunee, Boyer, and Nichols soils are saturated to a depth of 3 to 5 feet in wet periods.

Permeability is slow in the Kewaunee soil and moderate in the Nichols soil. In the Boyer soil the permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is high in the Nichols soil, moderate in the Kewaunee soil, and low in the Boyer soil. Runoff is medium. The surface layer of each of these soils is friable and is easily tilled. The shrink-swell potential is moderate in the Kewaunee soil and low in the Boyer and Nichols soils. In the Boyer soil, root growth is restricted for some plants by the sand and gravel substratum. The surface layer and the upper part of the subsoil are neutral. Free lime is in the substratum. The organic matter content is low to moderate. Natural fertility is medium in the Kewaunee and Nichols soils and low in the Boyer soil.

Most areas of these soils are farmed. The soils have fair potential for cultivated crops, hay, pasture, and trees. They have fair to poor potential for building site development.

These soils are suited to corn and small grain and to grasses and legumes for hay. Yields from these crops vary throughout each field because of the crop growth potential of each soil. Applying the correct amount of plant nutrients to each soil is difficult; the area of each soil is too small to treat separately. There is a slight hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In a few areas, slopes are long enough and uniform enough for contour tillage. In most areas, slopes are short and have no definite surface drainage pattern. Maintaining the content of organic matter also helps prevent erosion, increase the available water capacity, and improve the infiltration rate. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using these soils for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

These soils are suited to trees; a few areas remain in native hardwoods. Seedlings survive well. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

These soils are poorly suited to well suited to use as sites for buildings and local roads and streets and as septic tank absorption fields. Onsite investigation is needed to determine the suitability of the soil material for a specific use.

Capability subclass IIe; woodland suitability subclass: Kewaunee-2c, Boyer-3o, Nichols-1o.

KpC2—Kewaunee-Boyer-Nichols complex, 6 to 12 percent slopes, eroded. This complex consists of sloping soils on rolling convex side slopes on moraines. The areas are irregular in shape and range from 3 to 20 acres in size. The soils are well drained.

This unit consists of about 30 percent Kewaunee loam, 15 percent Boyer sandy loam, 15 percent Nichols very fine sandy loam, and 40 percent minor soils.

Typically, the surface layer of the Kewaunee soil is dark brown loam about 6 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay.

Typically, the surface layer of the Boyer soil is dark brown sandy loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark yellowish brown, friable sandy loam; the middle part is brown, friable loam; and the lower part is brown, friable gravelly sandy loam. The substratum to a depth of 60 inches is yellowish brown sand and gravel.

Typically, the surface layer of the Nichols soil is dark brown very fine sandy loam about 6 inches thick. The subsoil is about 13 inches thick. The upper part of the subsoil is pale brown, friable very fine sandy loam, and the lower part is light brown, friable very fine sandy loam. The substratum to a depth of 60 inches is pale brown very fine sand.

Included with these soils in mapping are small areas of Oakville and Tustin soils and small areas in which the underlying till and outwash deposits are mixed. The included soils make up about 40 percent of the complex. Also included are small areas of Kewaunee, Boyer, and Nichols soils where all of the surface layer has eroded and small areas where the slopes are steeper.

Permeability is slow in the Kewaunee soil and moderate in the Nichols soil. In the Boyer soil, permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is high in the Nichols soil, moderate in the Kewaunee soil, and low in the Boyer soil. Runoff is medium or rapid. Because the subsoil is exposed in places, these soils are more difficult to till than uneroded soils. Following rains, the Kewaunee soil is subject to puddling and crusting, which restrict the emergence of small-seeded crops. The shrink-swell potential is moderate in the Kewaunee soil and low in the Nichols and Boyer soils. In the Boyer soil, root growth is restricted for some plants by the sand and gravel substratum. The surface layer and upper part of the subsoil are neutral. Free lime is in the substratum. The organic matter content is low to moderate. Natural fertility is medium in the Kewaunee and Nichols soils and low in the Boyer soil.

Most areas of this map unit are farmed. These soils have fair potential for cultivated crops, hay, pasture, and trees. They have fair to poor potential for building site development and sanitary facilities.

These soils are suited to corn and small grain and to grasses and legumes for hay. Yields from these crops vary throughout each field because of the crop growth potential of each soil. Applying the correct amount of plant nutrients to each soil is very difficult; each soil is too small to treat separately. There is a moderate hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In very few areas are slopes long enough and uniform enough for contour tillage. In most areas, slopes are short and have no definite surface drainage pattern. Maintaining the content of organic matter helps prevent erosion, increases the available water capacity, and improves the infiltration rate. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using these soils for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

These soils are suited to trees; a few areas remain in native hardwoods. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. The growth rate of trees varies considerably in each map unit because of the complex of soils. Roads used by planting and harvesting equipment should be on the contour to prevent erosion.

These soils are fairly or poorly suited to use as sites for buildings and local roads and streets and as septic tank absorption fields. Onsite investigation is needed to determine the suitability of the soil material for a specific use.

Capability subclass IIIe; woodland suitability subclass: Kewaunee-2c, Boyer-3o, Nichols-1o.

KpD—Kewaunee-Boyer-Nichols complex, 12 to 20 percent slopes. This complex consists of moderately steep soils on convex side slopes on moraines. The areas are irregular in shape and range from 3 to 20 acres in size. The soils are well drained.

This unit consists of about 25 percent Kewaunee loam, 20 percent Boyer sandy loam, 15 percent Nichols very fine sandy loam, and 40 percent minor soils.

Typically, the surface layer of the Kewaunee soil is dark brown loam about 6 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown clay.

Typically, the surface layer of the Boyer soil is very dark brown sandy loam about 3 inches thick. The subsurface layer is pale brown sandy loam 3 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is brown, friable gravelly loam. The substratum to a depth of 60 inches is yellowish brown sand and gravel.

Typically, the surface layer of the Nichols soil is very dark grayish brown very fine sandy loam about 3 inches thick. The subsurface layer is pale brown very fine sandy loam about 3 inches thick. The subsoil is about 15 inches thick. The upper part is pale brown very fine sandy loam, and the lower part is light brown very fine sandy loam. The substratum to a depth of 60 inches is pale brown very fine sand.

Included with these soils in mapping are small areas of Lutzke, Plainfield, and Tustin soils and small areas in which the underlying till and outwash deposits are mixed. These included soils make up about 40 percent of this complex. Also included are small areas of the major soils where the slopes are more than 20 percent and small areas where as much as 5 inches of the surface layer has eroded.

Permeability is slow in the Kewaunee soil and moderate in the Nichols soil. It is moderately rapid in the surface layer and subsoil and very rapid in the substratum of the Boyer soil. The available water capacity is high in the Nichols soil, moderate in the Kewaunee soil, and low in the Boyer soil. Runoff is rapid. The surface layer of each of these soils is friable. In eroded areas, the Kewaunee soil can be tilled only within a narrow range of moisture content without large clods forming when the soil dries. In eroded areas, the soils are subject to puddling and crusting following heavy rains. The shrink-swell potential is moderate in the Kewaunee soil and low in the Nichols and Boyer soils. In the Boyer soil, root growth is restricted for some plants by the sand and gravel substratum. The surface layer and subsoil are neutral. Free lime is in the substratum. The organic matter content is low to moderate. Natural fertility is medium in the Kewaunee and Nichols soils and low in the Boyer soil.

Most areas of these soils are in pasture or woodland. The soils have poor potential for cultivated crops, building site development, and sanitary facilities.

These soils are poorly suited to cultivated crops because of a severe hazard of erosion.

Using these soils for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

These soils are suited to trees; many areas remain in native hardwoods. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. The growth rate of trees varies considerably in each mapped area because of the complex of soils. Roads used by planting and harvesting equipment should be on the contour to prevent erosion.

These soils are poorly suited to use as sites for buildings and local roads and streets and as septic tank absorption fields because of slope. Extensive leveling is needed for these uses.

Capability subclass IVe; woodland suitability subclass: Kewaunee-2c, Boyer-3o, Nichols-1r.

KrB—Kolberg loam, 2 to 6 percent slopes. This soil is gently sloping, moderately deep, and well drained. It is on uplands. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is reddish brown, firm clay loam; the middle part is reddish brown, firm clay; and the lower part is reddish brown, firm gravelly clay loam. The substratum, at a depth of about 29 inches, is white fractured dolomite. In some small areas of this soil the surface layer is darker colored. In other small areas as much as 4 inches of the surface layer was lost by erosion.

Included with this soil in mapping are small areas of Channahon and Kewaunee soils, which make up 5 to 10 percent of this map unit. Channahon and Kewaunee soils are well drained and are in positions on the landscape similar to that of the Kolberg soil. Also included are small areas that have dolomite at a depth of less than 20 inches and small areas that have many dolomite fragments.

Permeability is moderately slow or slow in the subsoil, and the available water capacity is low. Runoff is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate. Root growth is restricted by dolomite at a depth of 20 to 40 inches. The subsoil is mildly alkaline. The organic matter content is moderately low, and natural fertility is medium.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and hay. It has good potential for trees and pasture. It has fair to poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. In areas where the soil is eroded, yields from these crops are severely reduced in prolonged dry periods. The emergence of small-seeded plants may be impeded by crusting or puddling following heavy rains. There is a slight or moderate hazard of erosion on this soil. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas the slopes are long and uniform and can be tilled on the contour. Maintaining the content of organic matter also helps prevent erosion, increase the available water capacity, and control crusting. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil has good potential for trees; a few areas remain in native hardwoods. The low available water capacity of this soil reduces tree growth. There are only slight limitations in planting or harvesting trees. Plant competition is a concern. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used by harvesting and planting equipment should be on the contour to prevent erosion.

This soil is only fairly suited to use as building sites because of low strength, the moderate shrink-swell potential, and depth to rock. Foundations should be set on dolomite and backfilled with sand and gravel to overcome low strength and shrink-swell. Dolomite will have to be excavated before a basement can be constructed. This soil is poorly suited to local roads and streets because of low strength. Placing a thick layer of suitable roadfill on the subsoil can help compensate for this limitation. This soil is poorly suited to use as a septic tank absorption field because of depth to rock and the moderately slow permeability. Also, effluent may flow into the fractured dolomite and contaminate the ground water. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIe; woodland suitability subclass 2c.

KrC2—Kolberg loam, 6 to 12 percent slopes, eroded. This soil is sloping, moderately deep, and well drained. It is on uplands. The areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part of the subsoil is reddish brown, firm clay loam; the middle part is reddish brown, firm clay; and the lower part is reddish brown, firm gravelly clay loam. The substratum to a depth of about 26 inches is white, fractured dolomite. In some small areas this soil is not eroded. In other small areas the slopes are steeper, and the substratum is at a depth of slightly less than 26 inches.

Included with this soil in mapping are small areas of Channahon and Kewaunee soils, which make up 5 to 15 percent of this map unit. Channahon soils are well drained and are in a position on the landscape similar to that of the Kolberg soil. Kewaunee soils are well drained and are in a position on the landscape similar to that of the Kolberg soil. Also included are small areas of the Kolberg soil where all of the surface layer has eroded.

Permeability is moderately slow or slow in the subsoil, and the available water capacity is low. Runoff is medium. The surface layer is friable but has a narrow range of moisture content in which it can be tilled without forming large clods. The shrink-swell potential is moderate. Root growth is restricted by dolomite, which is at a depth of 20 to 40 inches. The surface layer and subsoil are mildly alkaline. The organic matter content is moderately low, and natural fertility is medium.

Many areas of this soil are farmed. This soil has fair potential for cultivated crops and hay. It has good potential for pasture and trees. It has fair to poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. Yields from these crops are severely reduced in prolonged dry periods. Small plants may be damaged by crusting or puddling following heavy rains. There is a moderate hazard of erosion on this soil. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. A few areas have slopes that are long enough and uniform enough for contour tillage. Using close-growing crops in much of the rotation helps control erosion. Maintaining the content of organic matter also helps prevent erosion, increase the available water capacity, and control crusting. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. The low available water capacity of this soil reduces tree growth. There are only slight limitations in planting and harvesting trees. Plant competition is a concern. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling, thinning, and removing less desirable trees can improve the quality of existing woodlands. Roads used when harvesting and planting should be on the contour to prevent erosion.

This soil is poorly suited to use as building sites because of low strength, the moderate shrink-swell potential, depth to rock, and slope. Foundations should be set on dolomite and backfilled with sand and gravel to overcome low strength and shrink-swell. Leveling operations expose the subsoil, which is difficult to revegetate. Dolomite should be excavated before constructing a basement. This soil is poorly suited to local roads and streets because of low strength. Placing a thick layer of suitable roadfill on the subsoil is needed. This soil is poorly suited to use as a septic tank absorption field because of depth to rock and the moderately slow permeability. Effluent may also flow into the fractured dolomite and contaminate the ground water. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIIe; woodland suitability subclass 2c.

LmA—Lamartine silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes in drainageways and depressions on till plains. It is subject to occasional flooding. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick and dark brown silt loam about 2 inches thick. The subsoil is about 22 inches thick. The upper part of the subsoil is dark yellowish brown, mottled, friable silt loam, and the lower part is brown, mottled, friable clay loam. The substratum to a depth of 60 inches is pale brown, mottled, friable loam.

Included with this soil in mapping are small areas of Mayville and Pella soils, which make up 5 to 15 percent of this map unit. Mayville soils are moderately well drained and are in slightly higher positions on the landscape than the Lamartine soil. Pella soils are poorly drained and are in a slightly lower position on the landscape than the Lamartine soil.

Permeability is moderate, and the available water capacity is high. Runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is moderate in the subsoil and low in the substratum. Most plant roots are restricted by saturated soil conditions. This soil is neutral or mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium. This soil is saturated to a depth of 1 to 3 feet during wet periods.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, small grains, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay. After heavy rains the surface layer crusts, resulting in poor emergence of small-seeded crops. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome crusting and ponding and ice sheeting.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to use as sites for buildings and local roads and streets and a septic tank absorption field. Drainage is needed to keep the soil from becoming saturated. Buildings constructed without basements should be designed to withstand the shrinking and swelling of the subsoil. Because local roads and streets are subject to damage from frost heave, a thick layer of suitable roadfill is needed over the subsoil. Septic tank absorption fields are subject to failure because of excessive wetness.

Capability subclass IIw; woodland suitability subclass 2o.

LuB—Lutzke sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on outwash plains and terraces. The areas are irregular in shape and range from 5 to 500 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is dark brown, friable gravelly clay loam, and the lower part is dark brown, friable gravelly loam. The substratum to a depth of 60 inches is brown, loose very gravelly sand (fig. 7). In some small areas the surface layer and the subsoil are slightly thicker. In other areas 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Plainfield and Wasepi soils, which make up 5 to 10 percent of this map unit. The Plainfield soils are excessively drained and are in positions on the landscape similar to those of the Lutzke soil. Wasepi soils are somewhat poorly drained and are in lower positions on the landscape than the Lutzke soil. Also included are

Figure 7.—Profile of Lutzke sandy loam, 2 to 6 percent slopes.

small areas of the Lutzke soil that have as much as 20 percent gravel and cobblestones in the surface layer.

Permeability is moderate or moderately rapid in the surface layer and subsoil and very rapid in the substratum. The available water capacity is very low. Runoff is medium. The surface layer is friable and is easily tilled. In some places cobblestones and gravel in the surface layer hinder tillage operations. The shrink-swell potential is low. Root growth is restricted for most plants by the very gravelly sand substratum, which is 20 to 30 inches from the surface. The surface layer and the subsoil are neutral or mildly alkaline. Free lime is in the substratum. The organic matter content and natural fertility are low.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has good potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. Yields from these crops are severely affected during prolonged dry periods. There is a slight or moderate hazard of erosion. Soil blowing is also a hazard. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas, slopes are long enough and uniform enough for contour tillage. Maintaining the content of organic matter also helps prevent erosion, increase the available water capacity, and improve the infiltration rate. Returning crop residue to the soil or adding other organic material helps improve fertility, tilth, and the available water capacity and reduces soil blowing. Some of the large areas of this soil are suitable for overhead irrigation.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees. Seedling mortality is a moderate hazard. The very low available water capacity of this soil reduces tree growth.

This soil is suited to use as sites for buildings and local roads and streets and as septic tank absorption fields. Effluent from septic tank absorption fields can move through the substratum rapidly and contaminate the ground water. This soil is a good source of sand and gravel for roads and building materials. There are many gravel pits on this soil. There is a danger of cutbanks caving in.

Capability subclass IIIe; woodland suitability subclass 4f.

LuC2—Lutzke sandy loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on outwash plains and terraces. The areas are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is dark brown sandy loam about 6 inches thick. The subsoil is about 14 inches thick; the upper part of the subsoil is dark brown, friable gravelly clay loam, and the lower part is friable gravelly loam. The substratum to a depth of 60 inches is brown, loose gravel and sand. In some small areas this soil is not eroded. In other areas it has slope of more than 12 percent.

Included with this soil in mapping are small areas of Boyer and Plainfield soils, which make up 5 to 10 percent of this map unit. Boyer soils are well drained and are in positions on the landscape similar to that of the Lutzke soil. Plainfield soils are excessively drained and are also in similar positions on the landscape. Also included are small areas of the Lutzke soil that have as much as 20 percent gravel and cobblestones in the surface layer.

Permeability is moderate to moderately rapid in the surface layer and subsoil and very rapid in the substratum. The available water capacity is very low. Surface runoff is medium to rapid. The surface layer is friable but is not easily tilled because subsoil material has been mixed into the plow layer. In some places, cobblestones and gravel hinder tillage. The shrink-swell potential is low. Root growth is restricted for most plants by the very gravelly sand substratum, which is at a depth of about 20 inches. The surface layer and the subsoil are neutral or mildly alkaline. Free lime is in the substratum. Organic matter content and natural fertility are low.

Some areas of this soil are farmed, and others are used for pasture or woodland. This soil has poor potential for cultivated crops and fair potential for building site development and sanitary facilities.

This soil is suited to small grain, grasses, and legumes. Yields from these crops are severely reduced during prolonged dry periods. Erosion is a moderate hazard; therefore, this soil is best suited to close-growing crops. Soil blowing is also a hazard. Minimum tillage, winter cover crops, spring plowing, long rotations that include a year of corn, and grassed waterways help prevent excessive soil loss. In only a few areas are slopes long enough and uniform enough for contour tillage. Maintaining the content of organic matter also helps prevent erosion, increase the available water capacity, and improve the infiltration rate. Returning crop residue to the soil or adding other organic material helps improve fertility, tilth, and soil moisture retention and reduce soil blowing.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees; a few areas remain in native hardwoods. The very low available water capacity of this soil reduces tree growth.

This soil is fairly suited to use as building sites, local roads and streets, and a septic tank absorption field because of slope. Effluent from septic absorption fields moves through the substratum rapidly and can contaminate the ground water. Leveling operations may expose the very gravelly sand substratum. This soil is a good source of sand and gravel for roads and building materials. There are many gravel pits in this soil. There is a danger of cutbanks caving in if this soil is excavated.

Capability subclass IVe; woodland suitability subclass 4f.

LuD—Lutzke sandy loam, 12 to 20 percent slopes. This soil is moderately steep and well drained. It is on eskers, kames, and outwash plains. The areas are long and narrow and range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 2 inches thick. The subsoil is about 15 inches thick; the upper part is dark brown, friable gravelly clay loam, and the lower part is friable gravelly loam. The substratum to a depth of 60 inches is brown, loose gravel and sand. In some small areas this soil has lost 3 to 5 inches of the surface layer by erosion. In other small areas, slopes are steeper.

Included with this soil in mapping are small areas of excessively drained Plainfield soils, which make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part of the Lutzke soil and very rapid in the substratum. The available water capacity is very low. Runoff is rapid. The shrink-swell potential is low. Plant roots of many crops are restricted by the very gravelly sand substratum, which is about 21 inches below the surface. The surface layer and subsoil are neutral or mildly alkaline. Free lime is in the substratum. The organic matter content and natural fertility are low.

Most areas of this soil are used for pasture or woodland. This soil has poor potential for row crops. It has poor potential for building site development and sanitary facilities.

Areas of this soil are suited to grasses and legumes. Yields from these crops are severely reduced during prolonged dry periods. Erosion is a severe hazard; therefore, this soil is best suited to close-growing crops. Soil blowing is also a hazard.

Using this soil for pasture or hay is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees; a few areas remain in native hardwoods. The very low available water capacity of this soil reduces tree growth. This soil has moderate equipment limitations because of slope. Hand planting is needed in some areas. Roads used in planting and harvesting should be on the contour to prevent erosion.

This soil is poorly suited to use as building sites, local roads and streets, and a septic tank absorption field because of slope. Leveling operations may expose the very gravelly sand substratum. This soil is a good source of sand and gravel for roads and building materials. There are many gravel pits on this soil. There is a danger of cutbanks caving in if this soil is excavated.

Capability subclass VIe; woodland suitability subclass 4f.

MbA—Manawa silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes in drainageways and depressions on till plains and in lacustrine basins. It is subject to occasional flooding. The areas are irregular in shape and range from 10 to 1,000 acres in size.

Typically, the surface layer is very dark brown silt loam about 7 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is brown, mottled, friable silty clay loam, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, mottled, firm silty clay.

Included with this soil in mapping are small areas of Cosad, Kewaunee, Mosel, and Poygan soils, which make up 5 to 15 percent of this map unit. Cosad and Mosel soils are in positions on the landscape similar to that of the Manawa soil. Kewaunee soils are well drained and are in higher positions on the landscape than the Manawa soil. Poygan soils are poorly drained and are in lower positions on the landscape than the Manawa soil. In some small areas near streams and major drainageways, the Manawa soil has sand and gravel deposits in the substratum.

Permeability is slow, and the available water capacity is moderate. Runoff is slow. This soil is easily tilled under optimum moisture conditions; tillage is difficult during wet periods. Plant roots are restricted by saturated soil conditions. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium. This soil is saturated to a depth of 1 to 3 feet during wet periods.

Most areas of this soil are farmed. This soil has good potential for cultivated crops if it is artificially drained. Most areas are drained by field tile. This soil has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome ponding and ice sheeting.

Overgrazing or grazing when the soil is wet can cause surface compaction, ponding, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the subsoil. Artificial drainage should be provided around footings to help control low strength and keep basements dry. Because local roads and streets are subject to damage from shrink-swell, frost heave, and low strength, suitable roadfill is needed on the subsoil. This soil is poorly suited to use as a septic tank absorption field because of slow permeability and saturated soil conditions to a depth of 1 to 3 feet during wet periods. Holding tanks are needed in areas that do not have commercial sewers.

Capability subclass IIw; woodland suitability subclass 2c.

McB—Manawa-Kewaunee-Poygan complex, 0 to 4 percent slopes. This complex consists of nearly level and gently sloping soils on till plains that are dissected by drainageways. The areas are irregular in shape and range from 10 to 3,000 acres in size. The soils are well drained, somewhat poorly drained, and poorly drained.

This map unit consists of about 55 percent Manawa silt loam, 25 percent Kewaunee loam, 15 percent Poygan silty clay loam, and 5 percent minor soils. Kewaunee soils are well drained and are on the convex tops of ridges and knolls. They are mostly eroded. Manawa soils are somewhat poorly drained and are on concave side slopes and in drainageways below the Kewaunee soil. Poygan soils are poorly drained and are in depressions.

Typically, the surface layer of the Manawa soil is very dark brown silt loam about 7 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is brown, mottled, friable silty clay loam, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, mottled, firm silty clay.

Typically, the surface layer of the Kewaunee soil is dark brown loam about 8 inches thick. The subsoil is about 15 inches thick; the upper part is reddish brown, firm clay loam, and the lower part is reddish brown, firm clay. The substratum to a depth of 60 inches is reddish brown, firm clay.

Typically, the surface layer of the Poygan soil is black silty clay loam about 10 inches thick. The subsoil is about 9 inches thick. The upper part of the subsoil is grayish brown, mottled, firm silty clay, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, firm clay.

Included with these soils in mapping are small areas of Mosel and Wauseon soils, which make up about 5 percent of this complex. Mosel soils are in positions on the landscape similar to that of the Manawa soil. Wauseon soils are in positions on the landscape similar to that of the Poygan soil.

Permeability is slow, and the available water capacity is moderate in the soils of this map unit. Runoff is medium on the Kewaunee soil and slow on the Manawa and Poygan soils. The surface layer is easily tilled under optimum moisture content, but tillage is difficult in wet periods. The Kewaunee soil is eroded, and in some areas the subsoil is exposed, making tillage difficult. Most plant roots are restricted in the Poygan and Manawa soils by saturated soil conditions. The major soils have moderate shrink-swell potential. The upper part of the subsoil is neutral, and the lower part of the subsoil and the substratum are mildly alkaline. Free lime is in the substratum. The organic matter content is moderate or high, and natural fertility is medium. The Manawa soil is subject to ponding and is saturated to a depth of 1 to 3 feet during wet periods. The Poygan soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of these soils are farmed. If they are artificially drained, these soils have good potential for cultivated crops. Most areas are drained by field tile. These soils have poor potential for building site development and sanitary facilities.

If they are artificially drained, these soils are well suited to corn and small grains and grasses and legumes for hay and pasture. Specialty crops such as sweet corn, green beans, and peas are also grown in some areas. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome ponding and ice sheeting.

Overgrazing or grazing when the soil is wet can cause surface compaction, ponding, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

These soils are suited to trees. There are only slight limitations in planting or harvesting trees on the Kewaunee and Manawa soils. Seedlings survive well if competing vegetation is controlled. Ponding and flooding are hazards to seedlings on the Manawa and Poygan soils. Planting on ridges can help overcome ponding and flooding. Forestry practices such as culling, thinning, and removing the less desirable trees can improve the quality of existing woodlands.

These soils are poorly suited to most building site development. Foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Artificial drainage on the Manawa and Poygan soils around buildings keep the soil from becoming saturated. Buildings constructed with basements may have a wetness problem. Because local roads and streets are subject to damage from shrink-swell, frost heave, and low bearing strength, placing suitable roadfill on the subsoil is needed. Slow permeability, saturated soil conditions, and flooding in the Manawa and Poygan soils are limitations for septic tank absorption fields.

Capability subclass IIw; woodland suitability subclass: Manawa-2c, Kewaunee-2c, Poygan-2w.

MlA—Mayville silt loam, 1 to 3 percent slopes. This soil is nearly level and gently sloping and moderately well drained. It is on broad flats between drumlins on till plains. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 26 inches thick; the upper part is dark yellowish brown, friable silty clay loam and silt loam, and the lower part is yellowish brown and grayish brown, friable clay loam. The substratum to a depth of 60 inches is light yellowish brown, mottled, friable loam.

Included with this soil in mapping are small areas of Dodge and Lamartine soils, which make up 5 to 10 percent of this map unit. Dodge soils are well drained and are in slightly higher positions on the landscape than the Mayville soil. Lamartine soils are somewhat poorly drained and are on concave side slopes along drainageways.

Permeability is moderate, and the available water capacity is high. Surface runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate in the subsoil and low in the substratum. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate or moderately low, and natural fertility is medium. This soil is saturated to a depth of 3 to 5 feet during wet periods. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair potential for building site development and poor potential for sanitary facilities.

This soil is well suited to corn and small grain and to grasses and legumes for hay and pasture. Saturated soil conditions to a depth of 3 to 5 feet can limit alfalfa yields.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted grazing during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

In most areas this soil is fairly suited to building site development and poorly suited to sanitary facilities. Saturated soil conditions to a depth of 3 to 5 feet during wet periods can result in wet basements. Artificial drainage should be provided around buildings to keep the soil from becoming saturated. Because local roads and streets are subject to damage from frost action and shrink-swell, placing a layer of suitable roadfill on the subsoil is needed. This soil is poorly suited to use as septic tank absorption fields because of saturated soil conditions to a depth of 3 to 5 feet during wet periods. This soil can be used as sites for mound sewage disposal systems.

Capability class I; woodland suitability subclass 2o.

MsA—Mosel loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes along drainageways in glaciofluvial valleys. This soil is flooded on rare occasions. The areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer consists of very dark brown loam about 9 inches thick and, below that, light brownish gray, pale brown, and strong brown loam about 3 inches thick. The subsoil is about 23 inches thick. The upper part of the subsoil is brown and strong brown, mottled, friable loam and sandy loam; the middle part is reddish brown, mottled, friable loam; and the lower part is reddish brown, mottled, firm silty clay loam and clay. The substratum to a depth of 60 inches is reddish brown, mottled, firm silty clay loam (fig. 8). In some small areas of this soil the surface layer is sandy loam.

Included with this soil in mapping are small areas of Kewaunee and Manawa soils, which make up 5 to 10 percent of this map unit. Kewaunee soils are well drained and are in higher positions on the landscape than the Mosel soil. Manawa soils are somewhat poorly drained and are in positions on the landscape similar to those of the Mosel soil.

Permeability is moderately slow, and the available water capacity is high. Surface runoff is slow. This soil is saturated to a depth of 1 to 3 feet during wet periods. Water collects on the lower slopes following heavy rains. This soil can be easily tilled except during wet periods. The shrink-swell potential is low in the upper part of the subsoil and moderate in the lower part of the subsoil and in the substratum. Root growth for most plants is restricted by saturated soil conditions. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Figure 8.—Profile of Mosel loam, 0 to 3 percent slopes. The surface layer and the upper part of the subsoil formed in loamy outwash deposits over clayey lacustrine deposits.

Most areas of this soil are farmed. If it is artificially drained, this soil has good potential for cultivated crops. It has poor potential for most building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome ponding and ice sheeting.

Overgrazing or grazing when the soil is wet can cause surface compaction, ponding, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as thinning and culling the less desirable trees can improve the quality of existing woodlands.

This soil is poorly suited to building site development. Foundations and footings should be designed to withstand the shrinking and swelling of the soil. Artificial drainage should be provided around the buildings to keep the soil from becoming saturated and to keep basements dry. Because local roads and streets are subject to damage from shrink-swell and low strength, suitable roadfill is needed over the subsoil. This soil is limited for use as septic tank absorption fields by saturated soil conditions and the moderately slow permeability.

Capability subclass IIw; woodland suitability subclass 2o.

MuA—Mundelein silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes in glacial lake basins and depressions. The areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is brown, mottled, friable silt loam and silty clay loam about 17 inches thick. The substratum to a depth of 60 inches is pinkish gray and brown stratified silt and very fine sand (fig. 9).

Included with this soil in mapping are small areas of Pella and Zurich soils, which make up 5 to 15 percent of this map unit. Pella soils are poorly drained and are in slightly lower positions on the landscape in depressions. Zurich soils are well drained and are in slightly higher positions on the landscape on small knolls and ridges.

Permeability is moderate or moderately slow, and the available water capacity is high. Surface runoff is slow. This soil is saturated to a depth of 1 to 3 feet during wet periods. Water collects on the lower slopes following heavy rains. The surface layer is friable and can be easily tilled except when wet. The shrink-swell potential is moderate in the subsoil and low in the substratum. Root growth is restricted by saturated soil conditions to a depth of 1 to 3 feet unless the soil is artificially drained. The upper part of the subsoil is neutral, and the lower part is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. If artificially drained, this soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is well suited to corn and small grains and to grasses and legumes for hay. It is also suited to specialty crops such as peas, carrots, green beans, and beets for canning; many areas are

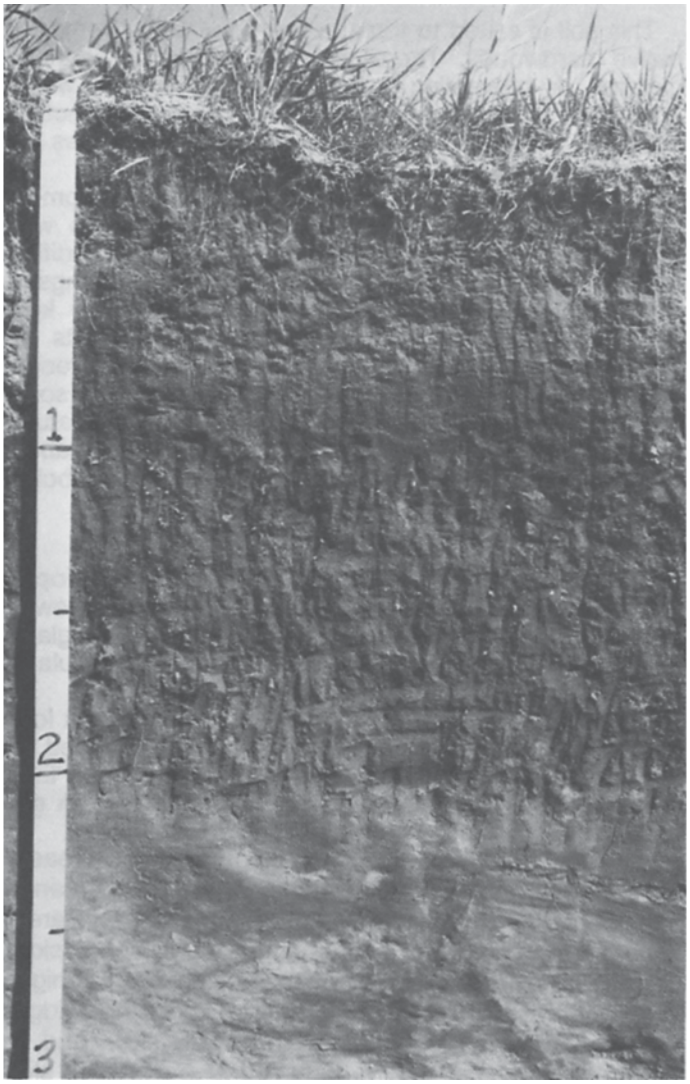


Figure 9.—Profile of Mundelein silt loam, 0 to 3 percent slopes.

used for specialty crops. Surface and subsurface drainage systems are needed for dependable yields. Legumes planted in depressions are subject to winterkill from ice sheeting. Maintaining the content of organic matter by returning crop residue to the soil or by adding other organic material helps improve fertility, tilth, and the infiltration rate.

Overgrazing or grazing when the soil is wet can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is poorly suited to trees, but some areas remain in native hardwoods. Planting operations should be restricted to dry periods to prevent damage to the surface layer. Harvesting operations should be done during dry periods or when the ground is frozen. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to use as building sites, local roads and streets, and septic tank absorption fields. Foundations and footings should be designed to prevent structural damage caused by the low strength of the substratum. Tile drains should be installed around footings to reduce wetness in basements. Local roads and streets are subject to damage because of the frost action potential and low strength of the subsoil; therefore, suitable roadfill is needed over the subsoil.

Capability class I; woodland suitability subclass 4o.

NsB—Nichols very fine sandy loam, 2 to 6 percent slopes. This soil is gently sloping and moderately well drained. It is on convex slopes on lacustrine plains. The areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part of the subsoil is pale brown, friable very fine sandy loam, and the lower part is brown, mottled, friable very fine sandy loam. The substratum to a depth of 60 inches is very pale brown, mottled, friable very fine sand with thin silt bands. In some small areas of this soil 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Boyer and Shiocton soils, which make up 5 to 10 percent of this map unit. Boyer soils are well drained and are in slightly higher positions on the landscape than the Nichols soil. Shiocton soils are somewhat poorly drained and are in lower positions on the landscape in drainageways.

Permeability is moderate, and the available water capacity is high. Surface runoff is slow or medium. The surface layer is friable and is easily tilled. The shrink-swell potential is low. The surface layer and subsoil are mildly alkaline. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is moderately low, and natural fertility is medium. This soil is saturated to a depth of 3 to 5 feet during wet periods. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair or good potential for building site development and sanitary facilities.

This soil is well suited to corn and small grain and to grasses and legumes for hay. It is also suited to specialty crops such as sweet corn, peas, and green beans for canning. There is a slight hazard of erosion. Soil blowing is also a hazard. Saturated soil conditions to a depth of 3 to 5 feet may reduce alfalfa yields. Minimum tillage, winter cover crops, and contour tillage help prevent excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and soil moisture retention and reduce soil blowing.

Using this soil for pasture or hay is also effective in controlling erosion and soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees. There are only slight limitations in planting or harvesting trees. Plant competition is a concern. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is only fairly or poorly suited to building site development and sanitary facilities because of wetness. Artificial drainage is needed around footings to keep basements from becoming wet. This soil is poorly suited to use as sites for local roads and streets because of frost action. Grading roads and streets to shed water and placing a layer of suitable roadfill on the subsoil to reduce frost damage are needed. This soil is poorly suited to use as septic tank absorption fields because of saturated soil conditions to a depth of 3 to 5 feet during wet periods. This soil can be used as sites for mound sewage disposal systems.

Capability subclass IIe; woodland suitability subclass 1o.

NsC2—Nichols very fine sandy loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on side slopes of lacustrine plains adjacent to drainageways. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown very fine sandy loam about 6 inches thick. The subsoil is about 13 inches thick. The upper part of the subsoil is pale brown, friable very fine sandy loam, and the lower part is light brown, friable very fine sandy loam. The substratum to a depth of 60 inches is very pale brown, friable very fine sand. In some small areas this soil is not eroded. In other small areas it has slope of more than 12 percent.

Included with this soil in mapping are small areas of well drained Boyer, Kewaunee, and Oakville soils, which make up 5 to 10 percent of this map unit. Boyer, Kewaunee, and Oakville soils are in positions on the landscape similar to that of the Nichols soil.

Permeability is moderate, and the available water capacity is high. Surface runoff is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is low. The surface layer and subsoil are mildly alkaline. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is moderately low, and natural fertility is medium.

Most areas of this soil are farmed, and other areas are in pasture and woodland. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has mostly fair or good potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. It is also suited to specialty crops such as sweet corn, peas, and green beans for canning. Erosion is a moderate hazard. Soil blowing is also a hazard. Minimum tillage, winter cover crops, and spring plowing help reduce excessive soil loss. Returning crop residue to the soil or adding other organic material helps to improve fertility and soil moisture retention and reduce soil blowing. In a few areas slopes are long enough and uniform enough for contour tillage. Diversions can be used to reduce slope length.

Using this soil for pasture or hay is also effective in controlling soil blowing and erosion. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation can help control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used when planting and harvesting should be on the contour to prevent erosion.

This soil is only fairly suited to use as septic tank absorption fields because of slope. Fields should be on the contour to prevent effluent from surfacing. This soil is only fairly suited to use as sites for dwellings because of slope. Extensive leveling is needed. Because local roads and streets are subject to damage by frost action, suitable roadfill is needed over the subsoil.

Capability subclass IIIe; woodland suitability subclass 1o.

OaB—Oakville loamy fine sand, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on side slopes of beach ridges and lake plains. The areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 29 inches thick; the upper part is strong brown, friable fine sand, and the lower part is yellowish brown, loose fine sand. The substratum to a depth of 60 inches is white, loose fine sand (fig. 10).

Included with this soil in mapping are small areas of Tedrow and Tustin soils, which make up 5 to 10 percent of this map unit. Tedrow soils are somewhat poorly drained and are in lower positions on the landscape than the Oakville soil. Tustin soils are well drained and are in positions on the landscape similar to those of the Oakville soil. Also included are small areas of sandy soils that are saturated to a depth of 3 to 5 feet.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is low. The

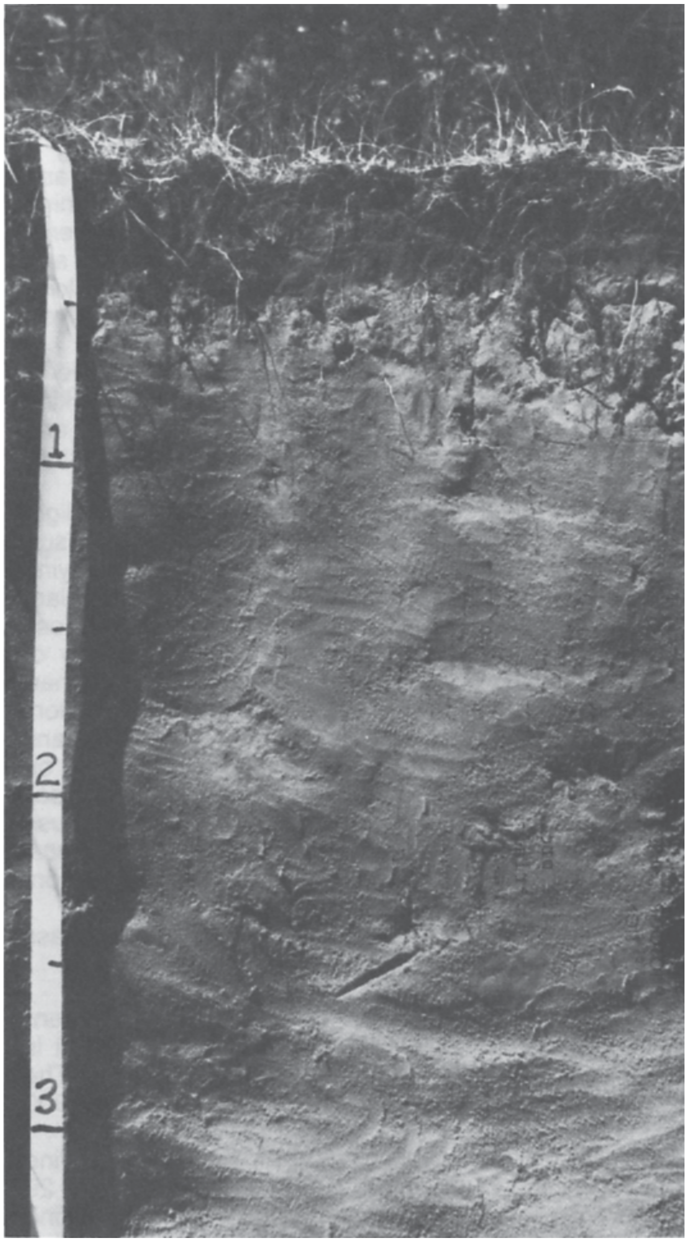


Figure 10.—Profile of Oakville loamy fine sand, 2 to 6 percent slopes.

subsoil is slightly acid. Free lime is in the substratum. The organic matter content and natural fertility are low.

Most areas of this soil are woodland or idle cropland. Some areas are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees in areas within about 4 miles of the Lake Michigan shoreline. The microclimate in these areas supplements the precipitation with fog and dew and thus partially offsets the low available water capacity of the soil. In these areas the summer air temperature is lower, thus reducing the amount of evaporation and transpiration. In these areas this soil is suited to canning crops such as peas and sweet corn. The microclimate actually extends about 8 miles west from the lakeshore. The small acreage of this soil beyond the 8-mile limit has poor potential for cultivated crops, hay, pasture, and trees. This soil has good potential for building site development and sanitary facilities.

This soil is suited to corn and small grain and to grasses and legumes for hay. Yields from these crops are severely reduced during prolonged dry periods. Soil blowing is a hazard. Minimum tillage, winter cover crops, and spring plowing help reduce losses caused by soil blowing. Returning crop residue to the soil or adding other organic material helps to improve the fertility and available water capacity of the soil and reduce soil blowing. Larger areas of this soil have potential for irrigation.

Using this soil for pasture or hay is also effective in controlling soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is fairly suited to trees; a few areas remain in native hardwoods. Many areas of this soil have been planted to pine. The low available water capacity and low natural fertility of this soil reduce tree growth. The lakeshore microclimate somewhat offsets the low available water capacity. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is well suited to use as building sites. Cutbanks can cave in if the soil is dry, and they can flow if the soil is wet. In most areas this soil is underlain by clay within a depth of 10 feet. This soil is suited to use as sites for local roads and streets and to use as septic tank absorption fields. Sewage effluent can pollute the ground water supply if it moves through this soil too rapidly for it to be purified.

Capability subclass IVs; woodland suitability subclass 2s.

OaC—Oakville loamy fine sand, 6 to 12 percent slopes. This soil is sloping and well drained. It is on moraines and side slopes of beach ridges. The areas are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 4 inches thick. The subsurface layer is brown loamy fine sand about 2 inches thick. The subsoil is about 20 inches thick; the upper part is strong brown, very friable fine sand, and the lower part is yellowish brown, loose fine sand. The substratum to a depth of 60 inches is white, loose fine sand.

Included with this soil in mapping are small areas of well drained Boyer and Nichols soils, which make up 5 to 10 percent of this map unit. Boyer and Nichols soils are in positions on the landscape similar to those of the Oakville soil.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow. The shrink-swell potential is low. The subsoil is slightly acid. Free lime is in the substratum. The organic matter content and natural fertility are low.

Most areas of this soil are in woodland, and some are in pasture. This soil has fair potential for pasture or trees in areas within about 4 miles of the Lake Michigan shoreline. The microclimate in these areas supplements the precipitation with fog and dew and thus partially offsets the low available water capacity of the soil. In these areas the summer air temperature is lower, thus reducing the amount of evaporation and transpiration. This microclimate actually extends about 8 miles west from the lakeshore. The small acreage of this soil beyond the 8-mile limit has poor potential for hay, pasture, and trees. This soil has fair potential for building site development and sanitary facilities.

This soil is poorly suited to cultivated crops and is best used for pasture or woodland. Yields of cultivated crops are low because of low natural fertility and low available water capacity. This soil is subject to soil blowing.

Using this soil for pasture is effective in controlling soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is fairly suited to trees; a few areas remain in native hardwoods. Many areas of this soil have been planted to pines. The low available water capacity and low natural fertility of this soil reduce tree growth. The lakeshore microclimate somewhat reduces the limitation of low available water capacity. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is fairly or poorly suited to use as building sites because of slope. Cutbanks are subject to cave-in if the soil is excavated. In most areas the soil is underlain by clay within a depth of 10 feet. This soil is moderately suited to use as sites for local roads and streets because of slope. Ditches are subject to water erosion. Seeding and mulching of ditches and banks can help overcome this hazard. This soil is moderately suited to use as septic tank absorption fields because of slope. Fields should be on the contour to prevent effluent from surfacing. Effluent may pollute the ground water supply if it moves through this soil too rapidly.

Capability subclass VIs; woodland suitability subclass 2s.

OgB—Oakville-Granby complex, 0 to 4 percent slopes. This complex consists of nearly level to gently sloping soils on beach ridges and in drainageways. The areas are irregular in shape and range from 10 to 500 acres in size. The soils are well drained and poorly drained. Granby soils are subject to frequent flooding.

This map unit consists of about 60 percent Oakville soils on ridges, 30 percent Granby soils in drainageways, and 10 percent minor soils.

Typically, the surface layer of the Oakville soil is dark brown loamy fine sand about 9 inches thick. The subsoil is about 29 inches thick; the upper part is strong brown, friable fine sand, and the lower part is yellowish brown, loose fine sand. The substratum to a depth of 60 inches is white, loose fine sand.

Typically, the surface layer of the Granby soil is black fine sandy loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is brown, mottled, friable loamy fine sand, and the lower part is light yellowish brown, mottled, loose fine sand. The substratum to a depth of 60 inches is brown, loose fine sand, and it also has mottles.

Included with these soils in mapping are small areas of Adrian and Tedrow soils, which make up about 10 percent of the complex. Adrian soils are very poorly drained and are in slightly lower positions on the landscape than Oakville and Granby soils. Tedrow soils are somewhat poorly drained and are in positions on the landscape between Oakville and Granby soils.

Permeability is rapid, and the available water capacity is low. Surface runoff is very slow. The shrink-swell potential is low. In the Granby soil, root growth is limited by ground water. The subsoil is slightly acid to mildly alkaline. Free lime is present in the substratum. The organic matter content is low in the Oakville soil and moderately high in the Granby soil. Natural fertility is low. The Granby soil has a seasonal high water table at a depth of less than 1 foot.

Most areas of these soils are in natural vegetation. The soils have poor potential for cultivated crops, hay, pasture, and woodland. They have good or poor potential for building site development and sanitary facilities.

These soils are presently being used as wildlife habitat. They are poorly suited to farming because of the difficulty in installing an artificial drainage system in the Granby soil and the low available water capacity of both of the soils.

The low available water capacity or wetness of the soils make them poorly suited to woodland.

The Granby soil is poorly suited to use as building sites if it is not drained. The Oakville soil, in most areas, is well suited to use as building sites. Cutbanks on these soils are subject to cave-in and flow when the soils are wet. The Granby soil is poorly suited to use as sites for local roads and streets because it is subject to flooding. Leveling some of the ridges of Oakville soil onto areas of Granby soil helps overcome this limitation. Roads and streets must be designed to allow the free movement of surface and underground water. The Granby soil is poorly suited to use as septic tank absorption fields because of wetness and flooding. Most areas of the Oakville soil are not wide enough for absorption fields.

Capability subclass IVs; woodland suitability subclass: Oakville-2s, Granby-3w.

OzC2—Omro loam, 4 to 12 percent slopes, eroded. This soil is gently sloping and sloping and well drained. It is on crests and side slopes on till plains. The areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is reddish brown and is about 22 inches thick; the upper part is friable clay loam, and the lower part is firm clay. The substratum to a depth of 60 inches is brown, friable loam. In some small areas of this soil, slopes are more than 12 percent. In other small areas, all of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Hochheim, Hortonville, and Kewaunee soils, which make up 5 to 15 percent of this map unit. Hochheim, Hortonville, and Kewaunee soils are well drained and are in positions on the landscape similar to those of the Omro soil. Also included are small areas that have loam in the lower part of the subsoil and some small areas that have clay loam in the upper part of the substratum. In some small areas the upper part of the substratum has pockets of sand and gravel.

Permeability is slow in the subsoil and moderate in the substratum. The available water capacity is moderate. Surface runoff is medium or rapid. Because the subsoil is exposed in places, this soil is more difficult to till than uneroded soils. This soil can be tilled only within a narrow range of moisture content without clods forming. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops and good potential for small grains, hay, pasture, and trees. It has fair or poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. The high reaction of this soil makes it especially well suited to legumes. There is a moderate hazard of erosion. The emergence of small-seeded crops is restricted by crusting on the surface layer following heavy rains. Minimum tillage, winter cover crops, spring tillage, and grassed waterways help prevent excessive soil loss. Some areas have slopes that are long enough and uniform enough for contour tillage. Diversions can be used to reduce slope length. Maintaining the content of organic matter helps prevent erosion, increases the available water capacity, and improves the infiltration rate. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Spraying or scalping the existing vegetation helps control plant competition. Roads used by planting and harvesting equipment should be on the contour to prevent erosion. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is mostly fairly suited to buildings that have footings or basements that extend into the substratum. Slope is the limiting factor. Buildings without basements or footings extending into the substratum must be designed to withstand the shrinking and swelling of the subsoil. This soil is poorly suited to use as sites for local roads and streets because of low strength. This hazard can be overcome by adding suitable subbase material. Road ditches and banks are subject to severe erosion. This soil is poorly suited to use as shallow septic tank absorption fields because of slow permeability. For deep systems installed in the substratum the slope is a limitation. Placing the deep system on the contour can overcome this limitation.

Capability subclass IIIe; woodland suitability subclass 2c.

Pa—Palms muck. This soil is nearly level and very poorly drained. It is in depressions in glacial lake basins. It is subject to frequent flooding. The areas are irregular in shape and range from 5 to 300 acres in size. Slopes range from 0 to 2 percent.

Typically, the upper layer is black muck about 13 inches thick. The second layer is very dark grayish brown muck about 14 inches thick. The third layer is very dark brown muck about 9 inches thick. The substratum to a depth of 60 inches is gray stratified silt and very fine sand. In some places, layers of mucky peat and peat as much as 6 inches thick are above the substratum.

Included with this soil in mapping are small areas of Keowns and Pella soils, which make up about 5 percent of this map unit. Keowns and Pella soils are poorly drained and are in slightly higher positions on the landscape than Palms muck. These soils formed in mineral soil material.

Permeability is moderately rapid in the organic layers and moderately slow in the substratum. The available water capacity is very high, and surface runoff is slow. The shrink-swell potential is low in the substratum. Most plant roots are restricted in this soil by ground water. The organic layer is neutral or mildly alkaline. Free lime is in the substratum. The organic matter content is very high, and natural fertility is low. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil remain in natural vegetation. This soil has poor potential for commonly grown cultivated crops, for building site development, and for sanitary facilities.

This soil is poorly suited to crops. A short growing season caused by frost late in spring and early in fall restricts the type of crops that can be grown. If drained, this soil has potential for specialty crops. Specialized equipment, which does not become mired, is needed for cultivation and harvest. If drained and cropped, this soil is subject to soil blowing and subsidence. These hazards can be minimized by raising water levels during the periods that crops are not grown.

Areas of this soil have poor potential for pasture. The surface layer has very poor trafficability, and use is restricted to dry periods. If not drained, this soil grows only a very low quality pasture.

This soil is poorly suited to woodland use. It has severe limitations for equipment operation. Seedling mortality, plant competition, and windthrow are severe hazards. Harvesting operations are restricted to winter, when the ground is frozen. Planting operations generally are restricted to hand planting on ridges. Trees on this soil are shallow rooted, and windthrow is a severe hazard. Even-aged harvesting methods can overcome this hazard. Flooding is frequent, and seedling survival is difficult during waterlogged soil conditions. Plant competition can be controlled by spraying or scalping the existing grasses and sedges. Older trees that are tolerant of waterlogged conditions grow rapidly. Roads or streets through areas of this soil should be planned so that the ground water flow is not hindered.

This soil is poorly suited to building site development because of wetness, flooding, and the low strength of the organic material. Local roads and streets are subject to damage from wetness, frost heave, and subsidence; therefore, the organic material should be replaced by coarse-textured base material. A drainage system is needed to remove excess water from the road area. This soil is poorly suited to use as septic tank absorption fields because of flooding and wetness.

Capability subclass IVw; woodland suitability subclass 3w.

Pe—Pella silt loam. This soil is nearly level and poorly drained. It is in depressions on till plains, and it is subject to occasional flooding. The areas are irregular in shape and range from 10 to 200 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is black silt loam about 10 inches thick. The subsoil is about 20 inches thick. It is grayish brown, mottled, friable silty clay loam. The upper part of the substratum is grayish brown, mottled, friable silty clay loam about 6 inches thick. The lower part of the substratum to a depth of 60 inches is grayish brown, mottled, friable silt loam.

Included with this soil in mapping are small areas of Lamartine and Palms soils, which make up 5 to 10 percent of this map unit. Lamartine soils are somewhat poorly drained and are in slightly higher positions on the landscape than the Pella soil. Palms soils are very poorly drained and are in slightly lower landscape positions than the Pella soil.

Permeability is moderate, and the available water capacity is high. Surface runoff is slow. The surface layer is easily tilled under optimum moisture content, but tillage becomes difficult during wet periods. The shrink-swell potential is moderate in the subsoil and low in the substratum. Plant roots are restricted in this soil by saturated soil conditions. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is high, and natural fertility is medium. This soil is saturated to a depth of 1 foot during wet periods.

Most areas of this soil are farmed. Many areas are artificially drained and used for cultivated crops. Some areas are used for pasture or woodland. This soil has poor potential for building site development and sanitary facilities.

If artificially drained, this soil is well suited to corn. Small grains tend to lodge because of the high organic matter content. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome these hazards. Corn grown for silage is the principal crop on this soil. Frost early in fall generally freezes corn before it is ripe for grain.

Overgrazing or grazing when the soil is wet can cause surface compaction, ponding, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is poorly suited to trees, but a few areas remain in native hardwoods. Occasional flooding and wetness are severe limitations to the use of equipment generally needed in woodland management and harvesting. Seedling mortality is a severe hazard because of the flooding and wetness. Plant competition is also a severe hazard. Vegetation should be scalped or chemically treated before planting. Trees on this soil are shallow rooted, and windthrow is a hazard. Even-aged harvesting can overcome this hazard. Harvesting operations should be carried out in winter to reduce damage to machinery and soil and to increase mobility. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development. Local roads and streets are subject to damage from wetness, flooding, low strength, and frost action. These hazards can be reduced by suitable roadfill to provide proper lift. Septic tank absorption fields are subject to damage from flooding and saturated soil conditions.

Capability subclass IIw; woodland suitability subclass 3w.

Pg—Pits, gravel. This miscellaneous area consists of open excavations from which sand and gravel have been removed to a depth of at least several feet. These pits are in sand and gravel outwash and in glacial till. The soil material on the bottom and sides of the pits ranges from sand and gravel to clay. The areas are elongated or circular in shape and range from 5 to more than 80 acres in size.

Included with this miscellaneous area in mapping are areas of spoil and large stones or boulders that are too large to crush. A few abandoned pits now have water at the bottom.

This miscellaneous area is not suitable for most land uses. Extensive filling and grading is needed to make it suitable for most uses.

Not assigned to a capability subclass or a woodland suitability subclass.

Ph—Pits, quarries. This miscellaneous area consists of open excavations from which dolomite has been removed to a depth of at least several feet. The areas are oblong or circular in shape and range from 3 to 40 acres in size.

The pits have nearly level bottoms and nearly vertical sides of dolomite. Some pits have water at the bottom. Included in mapping are areas of spoil and dolomite fragments that have not been crushed.

This miscellaneous area is not suitable for most land uses. Extensive filling and grading is needed to make it suitable for most land uses.

Not assigned to a capability subclass or a woodland suitability class.

PlB—Plainfield loamy sand, 2 to 6 percent slopes. This soil is gently sloping and excessively drained. It is on stream terraces and the sides of moraines. The areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is dark brown loamy sand about 13 inches thick. The subsoil is about 13 inches thick; the upper part is strong brown, very friable sand, and the lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is strong brown and light yellowish brown, loose sand. In some areas this soil is mildly alkaline below a depth of 48 inches.

Included with this soil in mapping are small areas of Tedrow and Tustin soils, which make up 5 to 10 percent of this map unit. Tedrow soils are somewhat poorly drained and are in lower positions on the landscape. Tustin soils are well drained and are in positions on the landscape similar to that of the Plainfield soil.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is low. The surface layer, subsoil, and upper part of the substratum are medium acid, and the lower part of the substratum is neutral. The organic matter content and natural fertility are low.

Most areas of this soil are in woodland or idle cropland. Some areas are farmed. This soil has poor potential for cultivated crops, hay, and pasture. It has poor potential for trees. It has good potential for building site development and sanitary facilities.

This soil is poorly suited to corn and small grains or to grasses and legumes for hay. Yields of these crops are low because of the low available water capacity. Some areas of this soil have potential for overhead irrigation. Many types of specialty crops can be grown if this soil is irrigated. There is a hazard of soil blowing. Minimum tillage, winter cover crops, and spring plowing can help reduce losses caused by soil blowing. Returning crop residue to the soil or adding other organic material helps to improve fertility and soil moisture retention and reduce soil blowing.

Using this soil for pasture or hay is also effective in controlling soil blowing. Yields of pasture or hay are low because of the low available water capacity. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition.

This soil is poorly suited to trees, but a few areas remain in native hardwoods. Many areas of this soil have been planted to pine. The low available water capacity and low natural fertility of this soil reduce tree growth. Forestry practices such as culling, thinning, and removing the less desirable trees can improve the quality of existing woodlands.

This soil is suited to use as building sites and local roads and streets. The cutbanks cave in if the soil is dry, and they flow if the soil is wet. This soil is suited to use as septic tank absorption fields. Sewage effluent can pollute the ground water supply if it moves through the soil too rapidly for it to be purified.

Capability subclass IVs; woodland suitability subclass 3s.

PlC—Plainfield loamy sand, 6 to 12 percent slopes. This soil is sloping and excessively drained. It is on stream terraces and sides of moraines. The areas are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 4 inches thick. The subsurface layer is brown loamy sand about 7 inches thick. The subsoil is about 12 inches thick; the upper part is strong brown, friable sand, and the lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is strong brown and yellowish brown, loose sand. In some areas this soil is mildly alkaline below a depth of 48 inches.

Included with this soil in mapping are small areas of Boyer and Tustin soils, which make up 5 to 10 percent of this map unit. Boyer and Tustin soils are well drained and are in positions on the landscape similar to those of the Plainfield soil.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow or medium. The shrink-swell potential is low. The surface layer, subsoil, and upper part of the substratum are medium acid, and the lower part of the substratum is neutral. The organic matter content and natural fertility are low.

Most areas of this soil are in woodland or pasture. Some areas are farmed. This soil has poor potential for cultivated crops, hay, and pasture. It has poor potential for trees and fair potential for building site development and sanitary facilities.

This soil is generally not suited to corn and small grains or to grasses and legumes for hay. Yields of these crops are limited by the low available water capacity. This soil is subject to soil blowing and erosion.

Using this soil for pasture is effective in controlling soil blowing and erosion. Yields are limited by the low available water capacity. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil has poor potential for trees, but a few areas remain in native hardwoods. Many areas of this soil have been planted to pine. The low available water capacity and low natural fertility of this soil reduce tree growth. Forestry practices such as culling, thinning, and removing the less desirable trees can improve the quality of existing woodlands.

This soil is fairly suited to use as building sites, local roads and streets, and a septic tank absorption field because of slope. The cutbanks cave in if the soil is dry, and they flow if the soil is wet. Leveling operations expose the sand substratum, which is difficult to revegetate. Septic tank absorption fields should be on the contour to prevent the effluent from surfacing. Sewage effluent can pollute the ground water supply if it moves through this soil too rapidly.

Capability subclass VIs; woodland suitability subclass 3s.

PlD—Plainfield loamy sand, 12 to 20 percent slopes. This soil is moderately steep and excessively drained. It is on the sides of moraines and escarpments. The areas are long and narrow and range from 3 to 20 acres in size.

Typically, the surface layer is dark brown loamy sand about 4 inches thick. The subsurface layer is brown loamy sand about 5 inches thick. The subsoil is about 11 inches thick; the upper part is strong brown, friable sand, and the lower part is yellowish brown, loose sand. The substratum to a depth of 60 inches is strong brown and yellowish brown, loose sand. In some small areas of this soil, slopes are steeper.

Included with this soil in mapping are small areas of Lutzke soils, which make up as much as 5 percent of this map unit. Lutzke soils are well drained and are in positions on the landscape similar to those of the Plainfield soil.

Permeability is rapid, and the available water capacity is low. Surface runoff is medium. The shrink-swell potential is low. The surface layer, subsoil, and upper part of the substratum are medium acid, and the lower part of the substratum is neutral. The organic matter content and natural fertility are low.

Most areas of this soil are in woodland. This soil has poor potential for cultivated crops, hay, and pasture. It has poor potential for trees, building site development, and sanitary facilities.

This soil generally is not suited to corn and small grains or to grasses and legumes for hay. Yields are limited by the low available water capacity. This soil is subject to soil blowing.

This soil is suited to pasture, but yields are generally low.

This soil is poorly suited to trees, but some areas remain in native hardwoods. Many areas have been planted to pine. Tree growth is slow because of the soil's low available water capacity and low natural fertility. Slope is a limitation to the use of equipment. Some steeper soils need hand planting. Roads for planting and harvesting equipment should be on the contour to prevent erosion.

This soil is poorly suited to use as sites for buildings and local roads and streets and as septic tank absorption fields because of slope. Extensive leveling exposes the sand substratum, which is difficult to revegetate. The cutbanks cave in if the soil is dry, and they flow if the soil is wet. Effluent from septic tanks may surface on the lower part of the slope.

Capability subclass VIIs; woodland suitability subclass 3s.

Po—Poygan silty clay loam. This soil is nearly level and poorly drained. It is in depressions and drainageways on till plains and in lacustrine basins. It is subject to frequent flooding. The areas are irregular in shape and range from 5 to 400 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is about 9 inches thick. The upper part of the subsoil is grayish brown, mottled, firm silty clay, and the lower part is reddish brown, mottled, firm clay. The substratum to a depth of 60 inches is reddish brown, firm clay that has light gray secondary lime concretions. In some small areas of this soil, free lime is at a depth of less than 15 inches. In other small areas the surface layer is muck as much as 6 inches thick.

Included with this soil in mapping are small areas of Manawa and Willette soils, which make up 5 to 15 percent of this map unit. Manawa soils are somewhat poorly drained and are in slightly higher positions on the landscape in drainageways. Willette soils are very poorly drained and are in slightly lower positions on the landscape than the Poygan soil.

Permeability is slow, and the available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is moderate. Root growth is restricted for most plants by saturated soil conditions. The upper part of the subsoil is mildly alkaline. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is high, and natural fertility is medium. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil are farmed. This soil has good potential for cultivated crops if it is artificially drained. Most areas are drained by field tile. This soil has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Small grains tend to lodge because of the high organic matter content. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems can help overcome these hazards.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. The equipment limitation and seedling mortality are severe because of frequent flooding and wetness. Plant competition is also a severe limitation. Seedlings should be planted on ridges. Trees on this soil are shallow rooted, and windthrow is a hazard. Clear cutting or area-selection harvesting can overcome this hazard. Trees should be harvested in winter to prevent machinery from becoming mired and thereby damaging the surface layer. Scalping the surface vegetation or spraying can control plant competition when the seedlings are small. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development. If buildings are constructed on this soil, foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Artificial drainage should be provided around the buildings to reduce wetness and shrink-swell. Buildings constructed with basements are subject to wetness. Local roads and streets are subject to damage from shrink-swell, frost action, low strength, and wetness. Suitable roadfill and drainage can help to overcome these limitations. Wetness and the slow permeability are severe limitations to the use of this soil as septic tank absorption fields.

Capability subclass IIw; woodland suitability subclass 2w.

ShA—Shiocton very fine sandy loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes along drainageways in glacial lake basins. It is subject to occasional flooding. The areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown very fine sandy loam about 9 inches thick. The subsoil is yellowish brown and light reddish brown, mottled, very friable very fine sandy loam 12 inches thick. The substratum to a depth of 60 inches is mostly yellowish brown, reddish brown, and light reddish brown, mottled very fine sand that has strata of silt in the lower part (fig. 11). In some small areas of this soil the surface layer is loamy very fine sand.

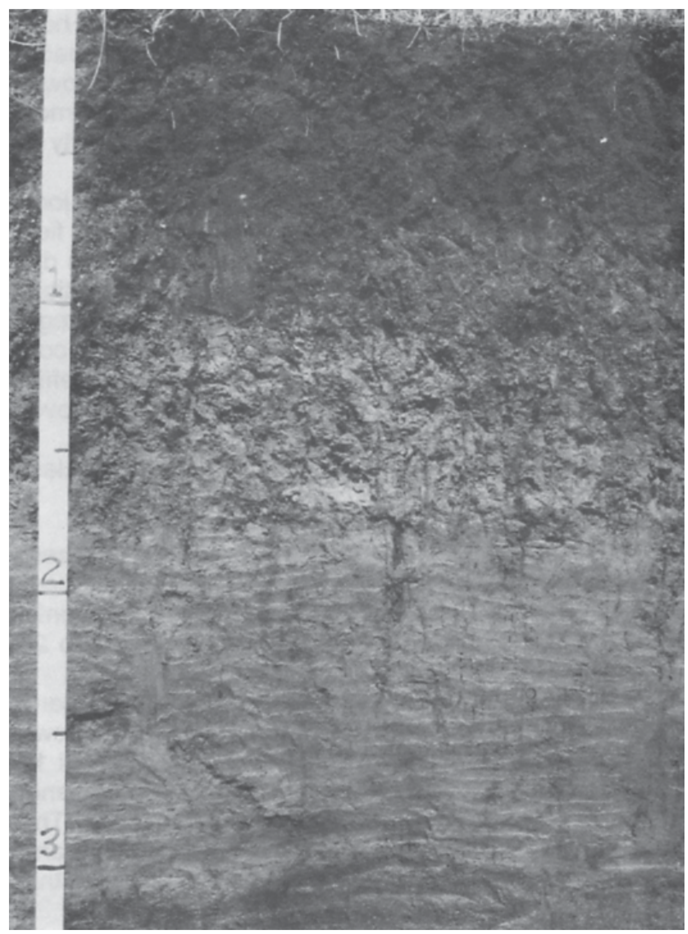


Figure 11.—Profile of Shiocton very fine sandy loam, 0 to 3 percent slopes.

Included with this soil in mapping are small areas of Mundelein, Nichols, and Pella soils, which make up 5 to 15 percent of this map unit. Mundelein soils are somewhat poorly drained and are in positions on the landscape similar to those of the Shiocton soil. Nichols soils are moderately well drained and are in higher positions on the landscape than the Shiocton soil. Pella soils are poorly drained and are in depressions.

Permeability is moderate, and the available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is low. Root growth is restricted in this soil by saturated soil conditions. Reaction is neutral and mildly alkaline throughout. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium. This soil is saturated to a depth of 1 to 3 feet during wet periods.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay. Legumes are subject to winterkill from ponding and ice sheeting. Surface and subsurface drainage help to correct problems caused by wetness.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; some areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well if competing vegetation is controlled by scalping or spraying before planting. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to use as sites for buildings and local roads and streets and as septic tank absorption fields because of occasional flooding and saturated soil conditions. If buildings are constructed on this soil, footings and foundations should be designed to offset the low strength of the subsoil. Artificial drainage should be provided around buildings to keep the soil from becoming saturated. Because local roads and streets are subject to damage from frost action, suitable roadfill should be placed on the subsoil. Septic tank absorption fields are subject to failure because of wetness.

Capability subclass IIw; woodland suitability subclass 2o.

SyA—Symco silt loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is on concave side slopes along drainageways on till plains and ground moraines. It is subject to rare flooding. The areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, mottled, friable loam; the middle part is brown, mottled, friable clay loam; and the lower part is reddish brown, mottled, friable loam. The substratum to a depth of 60 inches is reddish brown, mottled, friable loam.

Included with this soil in mapping are small areas of Brookston, Hortonville, and Manawa soils, which make up 5 to 10 percent of this map unit. Brookston soils are very poorly drained and are in lower positions on the landscape in depressions. Hortonville soils are well drained and are in higher positions on the landscape on convex side slopes. Manawa soils are somewhat poorly drained and are in positions on the landscape similar to those of the Symco soil.

Permeability is moderately slow, and the available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is moderate in the subsoil and low in the substratum. Plant roots are restricted by saturated soil conditions. The subsoil is mildly alkaline. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is moderate to high, and natural fertility is medium. This soil is saturated to a depth of 1 to 3 feet during wet periods.

Most areas of the soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Because the surface layer crusts and puddles following heavy rains, the emergence of small-seeded crops is poor. Legumes are subject to winterkill from ponding and ice sheeting.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; some areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to use as sites for shallow excavations, buildings, and local roads and streets. If buildings are constructed on this soil, footings should be designed to overcome the low strength of the substratum. Artificial drainage should be provided around the buildings to keep the soil from becoming saturated. Buildings that are constructed without basements should be designed to overcome the shrinking and swelling of the subsoil. Because local roads and streets are subject to damage from frost action and low strength, suitable roadfill should be placed on the subsoil. This soil is poorly suited to use as septic tank absorption fields because of wetness and the moderately slow permeability.

Capability subclass IIw; woodland suitability subclass 1o.

TeA—Tedrow loamy fine sand, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is in drainageways on lake plains and old beaches. The areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is about 18 inches thick. The upper part of the subsoil is strong brown, friable fine sand, and the lower part is yellowish brown, mottled, loose fine sand. The substratum to a depth of 60 inches is yellowish brown, mottled, loose fine sand.

Included with this soil in mapping are small areas of Granby and Oakville soils, which make up 5 to 15 percent of this map unit. Granby soils are poorly drained and are in lower positions on the landscape in depressions. Oakville soils are well drained and are in higher positions on the landscape on convex side slopes.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is low. Most plant roots are restricted by saturated soil conditions. The surface layer and subsoil are slightly acid, and the substratum is mildly alkaline. The organic matter content and natural fertility are low. This soil is saturated to a depth of 1 to 3 feet during wet periods. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has poor potential for cultivated crops, hay, or pasture and fair potential for trees. It has poor potential for most building site development and sanitary facilities.

This soil is poorly suited to corn and small grains or grasses and legumes for hay. Legumes are subject to winterkill from ponding and ice sheeting. Surface and subsurface drainage is needed to reduce wetness. Controlled drainage is necessary or this soil becomes droughty. Yields of most crops are limited by low available water capacity. Irrigation can be used on this soil to overcome the low available water capacity.

Overgrazing or grazing when the soil is wet can cause surface sealing and ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition. Yields from pasture plants are low because of the low available water capacity.

This soil is suited to trees; a few areas remain in native hardwoods. Some areas have been planted to pine. Seedlings should be planted on ridges to overcome seedling mortality from wetness. Windthrow is a hazard in some areas. Clear cutting or area selection harvesting can overcome this hazard. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development and sanitary facilities. Wetness and a hazard of frost action are limitations for local roads and streets. Installing drainage systems can overcome wetness, and placing a layer of good roadfill on the subsoil can help overcome frost action. The cutbanks cave in and flow when the soils are wet. Basements in this soil are subject to wetness. Drainage systems around the footings help overcome wetness.

Capability subclass IIIw; woodland suitability subclass 3w.

ThB—Theresa silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on ridges of till plains. The areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer consists of very dark grayish brown silt loam about 8 inches thick and, below that, brown silt loam 2 inches thick. The subsoil is about 24 inches thick. The upper part of the subsoil is brown, firm silt loam; the middle part is dark yellowish brown, firm silty clay loam; and the lower part is dark brown, firm clay loam and loam. The substratum to a depth of 60 inches is yellowish brown, friable loam. In some small areas of this soil 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Hochheim, Lamartine, and Mayville soils, which make up 5 to 10 percent of this map unit. Hochheim soils are well drained and are steeper than the Theresa soil. Mayville soils are moderately well drained, and Lamartine soils are somewhat poorly drained. These soils are in lower positions on the landscape than the Theresa soil.

Permeability is moderate, and the available water capacity is high. Surface runoff is medium. This soil is easily tilled. It does, however, have a tendency to crust or puddle after heavy rains. The shrink-swell potential is moderate in the subsoil and low in the substratum. The upper part of the subsoil is slightly acid, and the lower part is neutral or moderately alkaline. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is moderate, and natural fertility is medium. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair or good potential for building site development and sanitary facilities.

This soil is well suited to corn and small grain and to grasses and legumes for hay. It is also suited to specialty crops such as sweet corn, peas, and green beans for canning. This soil is especially well suited to alfalfa because of high reaction. Crusting or puddling of the surface layer following heavy rains may result in the poor emergence of small-seeded crops. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas, slopes are long enough and uniform enough for contour tillage. Maintaining the content of organic matter also helps prevent erosion and crusting. Returning crop residue to the soil or adding other organic material helps to improve fertility, tilth, and the available water capacity.

Using this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet and overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is well suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Plant competition is a concern. Spraying or scalping the existing vegetation helps control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used by harvesting and planting equipment should be on the contour to prevent erosion.

This soil has fair or good suitability for building site development and for sanitary facilities. It has fair suitability for buildings without basements because of the moderate shrink-swell potential and the low strength of the subsoil. These limitations do not affect foundations and basements that extend into the substratum. Because local roads and streets are subject to damage resulting from shrink-swell, frost action, and low strength, a suitable layer of roadfill should be placed on the subsoil. This soil is suitable for use as septic tank absorption fields.

Capability subclass IIe; woodland suitability subclass 1o.

TuB—Tustin loamy fine sand, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on terraces along rivers and old lake basins. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 8 inches thick. The subsoil is about 31 inches thick; the upper part is brown and yellowish brown, friable loamy fine sand, and the lower part is reddish brown, firm silty clay. The substratum to a depth of 60 inches is reddish brown, firm silty clay. In some small areas this soil does not have clayey material in the lower part of the subsoil but has clayey material within a depth of 36 inches. In other areas the substratum is as much as 10 percent gravel.

Included with this soil in mapping are small areas of Oakville, Plainfield, and Nichols soils, which make up 5 to 15 percent of this map unit. These included soils are in positions on the landscape similar to those of the Tustin soil but are not clayey in the lower part of the subsoil and in the substratum.

Permeability is moderately rapid in the surface layer and in the upper part of the subsoil and slow in the lower part of the subsoil and in the substratum. The available water capacity is moderate. Surface runoff is slow. The surface layer is friable and is easily tilled. The shrink-swell potential is low in the upper part of the subsoil and moderate in the lower part of the subsoil and in the substratum. The upper part of the subsoil is neutral. Free lime is in the lower part of the subsoil and in the substratum. The organic matter content is low or moderately low, and natural fertility is low.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Yields from these crops are severely reduced during prolonged dry periods. There is a hazard of soil blowing and erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil or adding other organic matter helps to improve fertility and tilth. Some large areas of this soil are suitable for irrigation.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing can cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil has poor to good suitability for building site development. It is poorly suited to sanitary facilities. It is suited to use as sites for buildings without basements. It is poorly suited to use as sites for buildings that have basements because of low strength in the lower part of the subsoil and in the substratum. This low strength limitation can be overcome by using a suitable base material and by proper design of foundations and footings. Septic tank absorption fields are subject to failure because of slow permeability in the lower part of the subsoil and in the substratum. This limitation can be overcome by installing the system in the sandy material and by increasing the size of the absorption area.

Capability subclass IIIe; woodland suitability subclass 3o.

Ud—Udorthents. These loamy and clayey soils are in areas where the original soil material has been removed or mixed by earth-moving equipment. They are in borrow areas, fill areas, and sanitary landfills. The areas are mostly rectangular in shape and range from 5 to 40 acres in size.

Included in the mapped areas are sandy soils and material such as cinders, broken concrete, and industrial waste. Also included are small dumps which have not been covered.

The soils in this map unit are too variable to rate for physical and chemical properties and for land use. Onsite investigation is needed to determine the potential for a specific use.

Not assigned to a capability subclass or a woodland suitability subclass.

WaA—Wasepi sandy loam, 0 to 3 percent slopes. This soil is nearly level and gently sloping and somewhat poorly drained. It is in drainageways and on concave side slopes of depressions on outwash plains and on stream terraces. It is subject to rare flooding. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The subsurface layer is brown, mottled sandy loam about 4 inches thick. The subsoil is about 12 inches thick. The upper part of the subsoil is yellowish brown, mottled, friable sandy loam, and the lower part is brownish yellow, mottled, friable gravelly loamy sand. The substratum to a depth of 60 inches is light brownish gray, mottled, loose sand and gravel.

Included with this soil in mapping are small areas of Boyer and Granby soils, which make up 5 to 15 percent of this map unit. Boyer soils are well drained and are in higher positions on the landscape than the Wasepi soil. Granby soils are poorly drained and are in lower positions on the landscape than the Wasepi soil. In some small areas of the Wasepi soil, thin bands of silt loam are below a depth of 40 inches.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. Surface runoff is slow. This soil is easily tilled, except during wet periods. The shrink-swell potential is low. Root growth is restricted for most plants by saturated soil conditions. The upper part of the subsoil is medium acid, and the lower part is neutral. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is low. This soil is saturated to a depth of 1 to 3 feet during wet periods.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, pasture, hay, and trees. It has poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Legumes are subject to winterkill from ponding and ice sheeting. Surface and subsurface drainage systems help overcome wetness in this soil.

Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Tree growth is restricted by saturated soil conditions and rare flooding. Forestry practices such as culling, thinning, and removing the less desirable trees can improve the quality of existing woodlands.

This soil is poorly suited to most kinds of building site development and to sanitary facilities because of wetness and seepage. Building sites should be covered with suitable fill material. Buildings that have basements are subject to wetness unless suitable drainage is provided. Local roads and streets should be designed to allow proper surface drainage from the surrounding area. Septic tank absorption fields are subject to failure because of flooding and saturated soil conditions to a depth of 1 to 3 feet during wet periods.

Capability subclass IIIw; woodland suitability subclass 3o.

We—Wauseon sandy loam. This soil is nearly level and very poorly drained. It is in depressions on till plains and in lacustrine basins. The areas are irregular in shape and range from 5 to 20 acres in size. Slopes range from 0 to 2 percent.

Typically, the surface layer is black sandy loam about 10 inches thick. The subsoil is about 16 inches thick. The upper part of the subsoil is grayish brown, mottled sandy loam and light brownish gray, mottled, very friable loamy sand; the middle part is grayish brown, mottled, friable sandy loam; and the lower part is dark grayish brown, mottled, friable sandy loam. The substratum to a depth of 60 inches is reddish brown, mottled, firm silty clay. In some small areas of this soil the subsoil is loam.

Included with this soil in mapping are small areas of Manawa, Mosel, and Willette soils, which make up 5 to 15 percent of this map unit. Manawa and Mosel soils are somewhat poorly drained and are in slightly higher positions on the landscape than the Wauseon soil. Willette soils are very poorly drained and are in slightly lower positions on the landscape than the Wauseon soil. Also included are small areas of the Wauseon soil that have a muck surface layer as much as 6 inches thick.

Permeability is rapid in the surface layer and subsoil and very slow in the substratum. The available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled, except during wet periods. The shrink-swell potential is low in the subsoil and high in the substratum. Most plant roots are restricted by saturated soil conditions. The surface layer and subsoil are neutral. Free lime is in the substratum. The organic matter content is high, and natural fertility is medium. This soil is saturated to a depth of less than 1 foot during wet periods.

Some areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, and pasture if it is artificially drained. It has poor potential for building site development and sanitary facilities.

If it is artificially drained, this soil is suited to corn and small grains and to grasses and legumes for hay and pasture. Small grains tend to lodge because of the high organic matter content. Legumes are subject to winterkill from ponding and ice sheeting. Installing surface and subsurface drainage systems helps overcome wetness.

This soil is suited to trees; a few areas remain in native hardwoods. Seedling mortality and equipment limitations are severe because of saturated soil conditions. Plant competition is also severe. Trees on this soil are shallow rooted, and windthrow is a hazard. Even-aged harvesting can overcome this hazard. Harvesting should be carried out in winter to prevent damage to equipment and soil. Spraying or scalping before planting can control plant competition. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development and septic tank absorption fields. Local roads and streets are subject to damage from wetness and low strength. Suitable fill and drainage can reduce these limitations. Septic tank absorption fields are subject to failure because of saturated soil conditions and very slow permeability.

Capability subclass IIIw; woodland suitability subclass 3w.

WoB—Waymor silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes on till plains. The areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dominantly brown silt loam about 6 inches thick. The subsoil is reddish brown loam about 22 inches thick. The substratum to a depth of 60 inches is dark brown loam and sandy loam. In some small areas of this soil 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Boyer, Hortonville, and Symco soils, which make up 5 to 10 percent of this map unit. Boyer and Hortonville soils are well drained and are in positions on the landscape similar to those of the Waymor soil. Symco soils are somewhat poorly drained and are in lower positions on the landscape than the Waymor soil.

Permeability is moderate, and the available water capacity is high. Surface runoff is medium. The surface layer is friable and is easily tilled. It tends to crust or puddle after heavy rains, thus restricting the emergence of small-seeded plants. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is neutral or mildly alkaline. Free lime is in the substratum. The organic matter content is low, and natural fertility is medium.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair potential for most kinds of building site development and good potential for most kinds of sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay and pasture. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil or adding other organic matter helps to improve fertility and increase the infiltration rate.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled by spraying or scalping the surface. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is fairly suited to most kinds of building site development and is mainly well suited to sanitary facilities. It is suited to use as septic tank absorption fields. It is only fairly suited to use as building sites because of low strength and the moderate shrink-swell potential in the subsoil. Using oversized steel-reinforced concrete foundations and backfilling with sand and gravel can help offset the low strength and shrinking and swelling. This soil is poorly suited to use as sites for local roads and streets because of low strength. This limitation can be offset by placing a layer of suitable roadfill on the subsoil.

Capability subclass IIe; woodland suitability subclass 1o.

WoC2—Waymor silt loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on convex side slopes on till plains and moraines. The areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer consists of dark brown silt loam about 6 inches thick and, below that, grayish brown and dark yellowish brown loam and silt loam about 2 inches thick. The subsoil is dark brown and reddish brown loam about 27 inches thick. The substratum to a depth of 60 inches is brown sandy loam. In some small areas this soil is not eroded.

Included with this soil in mapping are small areas of Boyer and Hortonville soils, which make up 5 to 10 percent of this map unit. Boyer and Hortonville soils are well drained and are in positions on the landscape similar to that of the Waymor soil. Also included are small areas of the Waymor soil where all of the surface layer has eroded.

Permeability is moderate, and the available water capacity is high. Surface runoff is medium to rapid. Because the subsoil is exposed in places, this soil is more difficult to till than uneroded soils. It tends to crust or puddle after heavy rains, thus restricting the emergence of small-seeded plants. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is neutral or mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, and pasture. It has good potential for trees and fair potential for building site development and sanitary facilities.

Areas of this soil are suited to corn and small grains and to grasses and legumes for hay. Because of crusting, the emergence of small-seeded crops is poor. There is a moderate hazard of erosion. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. In a few areas the slopes are long enough and uniform enough for contour cultivation. Diversions can be used to reduce slope length. Maintaining the content of organic matter also helps prevent erosion, increase the infiltration rate, and reduce crusting. Returning crop residue to the soil or adding other organic matter helps to improve fertility and tilth and increase soil moisture retention.

Using this soil for pasture or hay is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting and harvesting trees. Seedlings survive well when competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used by planting or harvesting equipment should be on the contour to prevent erosion.

This soil is fairly well suited to building site development and sanitary facilities. Septic tank absorption fields should be on the contour to prevent the effluent from surfacing. This soil has only fair suitability for use as building sites because of slope, the moderate shrink-swell potential, and low strength. Using oversized steel-reinforced concrete foundations and backfilling with sand and gravel can help offset the low strength and the shrinking and swelling. This soil is poorly suited to use as sites for local roads and streets because of low strength. This limitation can be overcome by placing a layer of suitable roadfill on the subsoil.

Capability subclass IIIe; woodland suitability subclass 1o.

WoD2—Waymor silt loam, 12 to 20 percent slopes, eroded. This soil is moderately steep and well drained. It is on convex side slopes on terminal and end moraines. The areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is reddish brown and brown loam about 10 inches thick. The substratum to a depth of 60 inches is brown sandy loam. In some small areas of this soil, slopes are more than 20 percent. In other areas this soil is not eroded.

Included with this soil in mapping are small areas of Hortonville and Lutzke soils, which make up 5 to 10 percent of this map unit. Hortonville and Lutzke soils are well drained and are in positions on the landscape similar to those of the Waymor soil. Also included are small areas of the Waymor soil where all of the surface layer has eroded.

Permeability is moderate, and the available water capacity is high. Surface runoff is rapid. Because the subsoil is exposed in places, this soil is more difficult to till than uneroded soils. This soil tends to crust or puddle after heavy rains, thus restricting the emergence of small-seeded plants. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is neutral or mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has good potential for small grains, hay, pasture, and trees. It has poor potential for row crops, building site development, and sanitary facilities.

This soil is suited to small grains, grasses and legumes, and hay. There is a severe hazard of erosion. This soil is best suited to close-growing crops. Such row crops as corn allow erosion to remove large quantities of the surface layer. Because of crusting following heavy rains, the emergence of small-seeded plants is poor. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. In a few areas the slopes are long enough and uniform enough for contour cultivation. Long rotations that include only a year of row crops help reduce erosion. Maintaining organic matter helps prevent erosion, increase the infiltration rate, and reduce crusting. Returning crop residue to the soil or adding other organic matter helps to improve fertility, tilth, and soil moisture retention.

Using this soil for hay or pasture is also effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and pasture plants in good condition.

This soil is well suited to trees; some areas remain in native hardwoods. Slope is a limitation in planting and harvesting trees. Seedlings survive well on north-facing and east-facing slopes if competing vegetation is controlled. Seedling mortality is a moderate hazard on south-facing and west-facing slopes because soils on these slopes are hotter and drier. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands. Roads used for planting and harvesting should be on the contour to prevent erosion. Some severely eroded areas may require hand planting.

This soil is poorly suited to use as local roads and streets, building sites, and a septic tank absorption field because of slope. Leveling operations for building require extensive earth movement.

Capability subclass IVe; woodland suitability subclass 1r.

WpB—Whalan silt loam, 2 to 6 percent slopes. This soil is gently sloping, moderately deep, and well drained. It is on uplands. The areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The subsoil is about 20 inches thick; the upper part is brown and dark brown, friable silt loam, and the lower part is reddish brown, firm silty clay. The substratum, at a depth of 32 inches, is light gray dolomite. In some small areas 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Channahon and Theresa soils, which make up 5 to 10 percent of this map unit. The Channahon and Theresa soils are well drained and are in positions on the landscape similar to that of the Whalan soil.

Permeability is moderately slow, and the available water capacity is moderate. Surface runoff is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate in the upper part of the subsoil and high in the lower part of the subsoil. Plant roots are restricted in these soils by the dolomite substratum at a depth of about 32 inches. The subsoil is neutral. The organic matter content is moderately low, and natural fertility is medium.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has poor potential for building site development and sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. Many slopes are long enough for contour tillage. Returning crop residue to the soil or adding other organic matter regularly helps to improve fertility, tilth, and soil moisture retention.

Using this soil for pasture or hay is also effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is suited to trees; a few small areas remain in native hardwoods. Plant roots are restricted by bedrock at a depth of about 32 inches. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is poorly suited to building site development and sanitary facilities. It is poorly suited to use as sites for buildings with basements because of the dolomite at a depth of about 32 inches. Effluent from septic tank absorption fields moves rapidly through the fractured dolomite to the ground water supply.

Capability subclass IIe; woodland suitability subclass 2o.

Wt—Willette muck. This soil is nearly level and very poorly drained. It is in depressions on till plains and in lacustrine basins. It is subject to frequent flooding. The areas are irregular in shape and range from 3 to 200 acres in size. Slopes range from 0 to 2 percent.

Typically, the upper layer is black muck about 28 inches thick. The substratum to a depth of 60 inches is dark gray silty clay in the upper part and brown silty clay in the lower part.

Included with this soil in mapping are small areas of Houghton and Poygan soils, which make up as much as 5 percent of this map unit. Houghton soils are very poorly drained and are in positions on the landscape similar to those of the Willette soil. Poygan soils are poorly drained and formed in silty and clayey deposits. They are at slightly higher elevations than the Willette soil.

Permeability is moderately rapid in the organic layer and very slow in the clayey substratum. The available water capacity is very high. Surface runoff is slow. The shrink-swell potential is high in the clayey substratum.

Plant roots are restricted in this soil by saturated soil conditions. The organic layer is mildly alkaline. Free lime is in the substratum. The organic matter content is very high, and natural fertility is low. This soil is saturated to a depth of less than 1 foot during wet periods.

Most areas of this soil remain in natural vegetation. This soil has poor potential for building site development.

This soil is poorly suited to use as cropland. A short growing season caused by frost late in spring and early in fall restricts the type of crops that can be grown. If this soil is artificially drained, mint and other specialty crops can be grown. Most areas do not have an adequate outlet for surface and subsurface drainage systems. Equipment that does not become mired is needed for cultivation. If artificially drained and used as cropland, this soil is subject to blowing and subsidence.

If artificially drained, this soil can be used for pasture, but production is low. The organic layer has very poor trafficability, and grazing is limited to dry periods.

This soil is poorly suited to use as woodland. It has severe limitations for equipment operation. Seedling mortality and plant competition are severe hazards. Harvesting should be restricted to winter, when the ground is frozen. Planting operations generally are restricted to hand planting on ridges. Trees on this soil are shallow rooted, and windthrow is a hazard. Even-aged harvesting can overcome this hazard. Flooding is frequent, and small-seedling survival is difficult because of the waterlogged soil conditions. Spraying or scalping the existing grasses and sedges can control plant competition. Older trees that are tolerant of waterlogged soil conditions grow rapidly. Roads or streets should be designed not to hinder the ground water flow.

This soil is poorly suited to building site development because of wetness, flooding, and the low strength of the organic material. Local roads and streets are subject to damage from frost heave and subsidence of the organic material; therefore, the organic material should be replaced by coarse-textured base material. Drainage is needed to remove excess water from road areas. This soil is poorly suited to use as septic tank absorption fields because of flooding and wetness.

Capability subclass IVw; woodland suitability subclass 3w.

WvB—Wyocena Variant sandy loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes on ground and end moraines. The areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is yellowish brown sandy loam about 4 inches thick. The subsoil is brown, friable sandy loam about 13 inches thick. The substratum to a depth of 60 inches is yellowish brown loamy sand. In some small areas of this soil 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Boyer and Waymor soils, which make up 5 to 15 percent of this map unit. Boyer and Waymor soils are well drained and are in positions on the landscape similar to those of the Wyocena Variant soil. In some small areas of this soil a layer of sand and gravel as much as 12 inches thick is in the substratum. Also included are small areas that have many stones on the surface.

Permeability is moderately rapid, and the available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled, except where there are stones. The shrink-swell potential is low. The subsoil is neutral, and the substratum is mildly alkaline. The organic matter content and natural fertility are low.

Most areas of this soil are farmed. This soil has fair potential for cultivated crops, hay, pasture, and trees. It has good potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. Yields from these crops are severely reduced during prolonged dry periods. This soil is subject to soil blowing, and there is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In many areas the slopes are long enough and uniform enough for contour tillage. Some areas of this soil have stones in the plow layer that hinder cultivation. Returning crop residue to the soil or adding other organic matter helps to improve tilth and fertility and increase soil moisture retention.

Using this soil for hay and pasture is effective in controlling erosion. Overgrazing can cause excessive runoff and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the soil and pasture plants in good condition.

This soil is suited to trees; a few areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well. The low available water capacity of this soil reduces tree growth. Some small areas are too stony for machine planting, and trees must be hand planted. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is well suited to most kinds of building site development and to septic tank absorption fields. Cutbanks of shallow excavations are subject to caving.

Capability subclass IIIe; woodland suitability subclass 3o.

WvC2—Wyocena Variant sandy loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on ground and end moraines. The areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown sandy loam about 7 inches thick. The subsurface layer is yellowish brown sandy loam about 1 inch thick. The subsoil is brown, friable sandy loam about 13 inches thick. The substratum to a depth of 60 inches is yellowish brown loamy sand. In some small areas this soil is not eroded. In other areas slopes are more than 12 percent.

Included with this soil in mapping are small areas of Boyer and Waymor soils, which make up 5 to 15 percent of this map unit. Boyer and Waymor soils are well drained and are in positions on the landscape similar to those of the Wyocena Variant soil. In some small areas of this soil all of the surface layer has been lost by erosion. In other small areas many stones are on the surface. In some small areas, a layer of sand and gravel as much as 12 inches thick is in the substratum.

Permeability is moderately rapid, and the available water capacity is low. Surface runoff is medium. The surface layer is friable and can be easily tilled, except where there are stones. The shrink-swell potential is low. The subsoil is neutral, and the substratum is mildly alkaline. The organic matter content and natural fertility are low.

Most areas of this soil are in cropland. This soil has poor potential for cultivated crops and fair potential for hay, pasture, and trees. It has fair potential for building site development and sanitary facilities.

This soil is suited to row crops. There is a moderate hazard of erosion. Crop yields are severely reduced during dry periods. This soil is subject to soil blowing. In some areas, stones in the plow layer make cultivation difficult. If this soil is used for cropland, long rotations that include a year of row crops are needed. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. In a few areas the slopes are long enough and uniform enough for contour tillage. Returning crop residue to the soil or adding other organic matter helps to improve tilth and fertility and increase soil moisture retention.

Using this soil for hay and pasture is effective in controlling erosion. Overgrazing can cause soil compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep the soil and pasture plants in good condition.

This soil is suited to trees; some areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. The low available water capacity of this soil reduces tree growth and causes seedling mortality during dry periods. Some small areas are too stony for machine planting, and trees must be hand planted. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

Because of slope this soil is only fairly suited to building site development and septic tank absorption fields. Leveling operations expose the subsoil and substratum, which are difficult to revegetate. Local roads and streets and septic tank absorption fields should be on the contour. There is a hazard of erosion in road ditches and banks.

Capability subclass IVe; woodland suitability subclass 3o.

ZuB—Zurich silt loam, 2 to 6 percent slopes. This soil is gently sloping and well drained. It is on convex side slopes in glacial lake basins. The areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is about 15 inches thick; the upper part is dark brown, friable silty clay loam, and the lower part is brown, friable silt loam. The substratum to a depth of 60 inches is brown, mottled, friable silt loam (fig. 12). In some small areas of this soil the surface layer is darker colored. In other areas 3 to 5 inches of the surface layer has been lost by erosion.

Included with this soil in mapping are small areas of Mundelein and Nichols soils, which make up 5 to 15

Figure 12.—Profile of Zurich silt loam, 2 to 6 percent slopes.

percent of this map unit. Mundelein soils are somewhat poorly drained and are in drainageways. The Nichols soils are well drained and are in positions on the landscape similar to those of the Zurich soil. Also included are small areas of this soil that are saturated to a depth of 3 to 5 feet during wet periods.

Permeability is moderate, and the available water capacity is high. Surface runoff is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium. Water may collect on lower slopes for short periods after heavy rains.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair to poor potential for building site development and sanitary facilities.

This soil is well suited to corn and small grains and to grasses and legumes for hay. It is well suited to specialty crops such as peas, green beans, carrots, and beets for canning. Because of the high reaction, this soil is especially well suited to legumes. There is a slight or moderate hazard of erosion. Minimum tillage, winter cover crops, spring plowing, and grassed waterways help prevent excessive soil loss. Many slopes are long enough for contour stripcropping. Returning crop residue to the soil or adding other organic matter increases the infiltration rate and improves tilth.

Using this soil for pasture or hay is effective in controlling erosion. Overgrazing or grazing when the soil is wet can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is fairly suited to most kinds of building site development and is well suited to poorly suited to sanitary facilities. If buildings are constructed on this soil, foundations and footings should be designed to offset the low strength of the substratum. Because local roads and streets are subject to damage from frost action, suitable roadfill is needed over the subsoil.

Capability subclass IIe; woodland suitability subclass 1o.

ZuC2—Zurich silt loam, 6 to 12 percent slopes, eroded. This soil is sloping and well drained. It is on concave side slopes in glacial lake basins. The areas are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown silt loam about 6 inches thick. The subsoil is about 13 inches thick; the upper part is dark brown, friable silty clay loam, and the lower part is brown, friable silt loam. The substratum to a depth of 60 inches is brown, friable silt loam. In some small areas this soil is not eroded. In other areas it has slope of more than 12 percent.

Included with this soil in mapping are small areas of Nichols soils, which make up 5 to 15 percent of this map unit. Nichols soils are well drained and are in positions on the landscape similar to those of the Zurich soil. Also included are small areas of this soil where all of the surface layer has eroded.

Permeability is moderate, and the available water capacity is high. Surface runoff is rapid. Because some of the subsoil is exposed, this soil is more difficult to till than uneroded soil. In small areas where all of the surface layer has eroded the soil can be tilled without forming clods only within a very narrow range in moisture content, and it is subject to crusting after heavy rains. These small areas of severely eroded soils are scattered throughout this map unit and control the time of tillage for the entire unit. The shrink-swell potential is moderate in the subsoil and low in the substratum. The subsoil is mildly alkaline. Free lime is in the substratum. The organic matter content is moderate, and natural fertility is medium.

Most areas of this soil are farmed. This soil has good potential for cultivated crops, hay, pasture, and trees. It has fair or poor potential for building site development and sanitary facilities.

This soil is suited to corn and small grains and to grasses and legumes for hay. The high reaction of this soil makes it especially well suited to legumes. There is a moderate hazard of erosion. This soil is subject to crusting, which results in poor emergence of small-seeded crops. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil loss. A few areas have slopes that are long enough for contour stripcropping. Returning crop residue to the soil or adding other organic matter helps to improve tilth and fertility and increase the infiltration rate.

Using this soil for hay or pasture is effective in controlling erosion. Grazing when the soil is wet or overgrazing can cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep pasture plants and the soil in good condition.

This soil is well suited to trees; a few small areas remain in native hardwoods. There are only slight limitations in planting or harvesting trees. Seedlings survive well if competing vegetation is controlled. Forestry practices such as culling the less desirable trees and thinning can improve the quality of existing woodlands.

This soil is fairly suited to most kinds of building site development and fairly or poorly suited to sanitary facilities. If buildings are constructed on this soil, foundations and footings should be designed to offset the low strength of the substratum. Because local roads and streets are subject to damage from frost action, a layer of suitable roadfill is needed over the subsoil. Ditches and ditchbanks are subject to severe erosion. This soil is only fairly suited to use as septic tank absorption fields because of slope. Installing the absorption fields on the contour can help overcome this limitation.

Capability subclass IIIe; woodland suitability subclass 1o.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

John R. Buchholz, agricultural agent, University Extension Service, University of Wisconsin, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

More than 488,000 acres in the survey area was in farms in 1969, according to the U.S. Department of Commerce (*11*). Of this total, more than 338,000 acres was in cropland, 51,000 acres was in pasture, and the rest was in other farm uses.

The potential for additional acres of cropland in this survey area is fair to good. If intensive conservation practices are used, about 30,000 additional acres can be used as cropland. This acreage will come out of pasture, woodland, and other farm uses. In addition, the productive capacity of all cropland can be increased by using the latest crop production technology.

Acreage in cropland and pasture has gradually decreased as more land is used for urban development. From 1964 to 1969, the acreage in farms decreased by 30,000 acres. This land went to parks, roads, houses, and other nonfarm uses.

Soil erosion is the major problem on about two-thirds of the cropland in Calumet and Manitowoc Counties. If the slope is more than 2 percent, erosion is a hazard.

Loss of the surface layer through erosion is damaging for three reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a moderately fine textured or fine textured subsoil, for example, Briggsville, Kewaunee, and Kolberg soils. Erosion also is damaging to soils that have a layer that restricts the depth of the root zone. Channahon, Kolberg, and Whalan soils, for example, are shallow or only moderately deep to dolomite bedrock. Erosion also reduces productivity on soils that tend to be droughty, for example, Oakville and Plainfield soils.

Second, soil erosion on cropland results in poor tilth and reduces the water infiltration rate. If part of the subsoil is exposed, the soil becomes more difficult to till than uneroded soils. Eroded soils are also subject to puddling and crusting, which result in poor emergence of small-seeded plants. The lower rate of water infiltration in eroded soils results in more runoff and increases the erosion hazard.

Third, because of soil erosion on farmland, sediment enters streams. Controlling erosion minimizes the pollution of streams and rivers by sediment and improves the quality of water for municipal use, recreation use, and for fish and other wildlife.

Erosion-control practices provide a protective surface cover, reduce runoff, and increase the rate of water infiltration. A cropping system that maintains a vegetative cover on the surface for an extended period can hold soil erosion losses to an amount that does not reduce the productivity of the soils. On dairy farms, which need pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land, provide nitrogen, and improve tilth for the crops that follow in rotation.

On some soils, contour tillage or terracing is not practical because the slopes are so short and irregular. On these soils, cropping systems that provide substantial vegetative cover are necessary to control erosion. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are more difficult to use successfully on the eroded soils. No-tillage for corn, which is common on an increasing acreage, is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area. Delaying plowing until spring is also effective in controlling erosion. Fall plowing removes the vegetative cover that protects the surface layer from erosion by winter winds and spring runoff.

Terraces and diversions reduce the length of the slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have a uniform slope.

Contouring and contour stripcropping are widely used erosion-control practices in some parts of the survey area. They are best adapted to soils that have smooth, uniform slopes.

Soil blowing is a hazard on the sandy Oakville and Plainfield soils and on organic soils that are drained and used as cropland. Soil blowing results in soil loss and may damage young crops in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining a vegetative cover or mulching minimizes soil blowing. Windbreaks are also effective in minimizing soil blowing.

Information on the design of erosion-control practices for each kind of soil is available at the local offices of the Soil Conservation Service.

Soil drainage is the major management need on about one-third of the acreage of cropland in Calumet and Manitowoc Counties.

Unless artificially drained, the somewhat poorly drained, poorly drained, and very poorly drained soils are so wet that crops are damaged in most years. These wet soils include the Brookston, Cosad, Granby, Lamartine, Manawa, Mosel, Mundelein, Pella, Poygan, Shiocton, Symco, Tedrow, Wasepi, and Wauseon soils.

Kewaunee, Omro, Kolberg, Briggsville, and Zurich soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Water also tends to pond on the lower slopes following heavy rains.

The design of surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most of the poorly drained soils used for intensive row crops. Drains have to be more closely spaced in soils that have slow permeability than in the more permeable soils. Suitable outlets for tile drainage are difficult to find in some areas of poorly drained soils.

Organic soils such as Adrian, Houghton, Palms, and Willette soils also need drainage for crop production. These soils oxidize and subside after they are drained. Special drainage systems are needed on these soils to control depth and period of drainage. Keeping the water table at a level beneficial to crops during the growing season and raising the level to the surface at other times minimize the oxidation and subsidence of organic soils.

Granby, Tedrow, and Wasepi soils generally have a seasonal wetness problem in the spring, but they become droughty if drained. To achieve the best crop production on these soils, the depth of drainage should be controlled, and these soils may need irrigating in dry seasons.

Drainage also increases the length of the growing season. Soils that are adequately drained can be tilled earlier in the spring and reach a temperature that is suitable for crop growth sooner in the spring.

Information on drainage design for each kind of soil is available at the local offices of the Soil Conservation Service.

Soil fertility is naturally low or medium in most of the upland soils in the survey area. Fertility can be improved by choosing a cropping system that adds organic matter to the soils. On dairy farms a diversified cropping system is used, and manure is added. Where specialty crops, such as snap beans or peas, are grown, green manure crops are needed and all remaining crop residue should be returned to the soil.

Commercial fertilizer gives good crop response for most crops. The mineral soils in the survey area are generally medium to high in potassium and medium to low in phosphorus. Organic soils are low in phosphorus and potassium. Many of the soils have a large amount of lime in the surface layer, and pH is generally 6.5 to 7.5. In many of the mineral soils the subsoil is alkaline. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected yields. Assistance in determining the kinds and amount of fertilizer and lime to apply is available at the University of Wisconsin, Extension Service.

Soil tilth is an important factor in the germination of seeds, plant emergence, and the infiltration of water into the soil. Soils with good tilth are granular and porous.

Most of the well drained soils in the survey area have a loam or silt loam surface layer that is light in color and low or moderate in organic matter content. Many of these soils have lost some of the original surface layer by erosion. Generally, the structure of these soils is weak, and intense rainfall causes the formation of a crust on the surface layer. This crust is hard when dry and nearly impervious to water. It restricts the growth of small-seeded plants, which have difficulty in emerging through it. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic matter can help improve soil structure and reduce crust formation.

Fall plowing is generally not a good practice on soils in the survey area that have a light colored loam or silt loam surface layer. The winter winds and spring runoff remove a large amount of the surface layer if these soils are fall plowed.

The wet soils in the survey area have a moderate to very high organic matter content and have a dark colored surface layer. They are not as subject to crusting as the well drained soils. If cultivated, they still need regular additions of organic matter to maintain the content of organic matter.

Field crops suited to the soils and climate of the survey area include many that are not commonly grown. Corn is the most extensively grown row crop. Grain sorghum, sunflowers, sugar beets, and similar row crops can be grown if economic conditions are favorable.

Oats and wheat are the common close-growing cereal crops. Rye and barley can also be grown if economic conditions are favorable. Alfalfa, timothy, red clover, bromegrass, fescues, and bluegrass can be grown for seed.

Special crops grown commercially in the survey area are vegetables, fruits, and nursery plants. Snap beans, English peas, potatoes, sweet corn, canning beets, and carrots are the commonly grown vegetable crops. Cabbage, tomatoes, Brussels sprouts, broccoli, and similar vegetable crops can also be grown if the market is favorable. A small acreage is used for strawberries, raspberries, apples, and cherries.

Deep lacustrine soils that have good natural drainage are especially well suited to growing root crops such as carrots and beets. Briggsville, Nichols, and Zurich soils are examples. These soils are generally free of stones. Mundelein and Shiocton soils are also well suited if adequately drained. Many of the other soils in the survey area are suited to growing above-ground vegetable and fruit crops. If irrigated, Oakville and Plainfield soils are also well suited to vegetables.

The nearly 50,000 acres of organic soils in the survey area may have potential for growing specialty crops such as mint and cranberries. Adrian, Houghton, Palms, and Willette soils are examples. In most areas, these soils are in native vegetation. These soils need drainage and careful crop selection for good production. The growing season on these soils is short, and crops often suffer frost damage. These soils are also low in natural fertility.

The latest information for growing special crops can be obtained from the University of Wisconsin, Extension Service.

Pasture plants grown in the survey area can be separated into two types—rotation pasture and perennial or permanent pasture.

Rotation pastures are areas that are used for cultivated crops in some years and for pasture in one or more years as part of the cropping system. They generally consist of a grass-legume mixture. Perennial pastures are occupied by perennial pasture plants or by self-seeding annuals but more often are a combination of both types. This kind of pasture remains unplowed for many years and generally occupies soils on slopes of more than 15 percent.

Good management of rotation pasture plants helps to provide forage of high quality and maintains the vigor of the plants. One of the goals in the management of grass-legume pasture is to maintain the legumes in the stand as long as possible. Suitable management practices for rotation pasture are: (1) delay grazing in the spring until alfalfa and other upright legumes are 8 to 10 inches high and Ladino clover and other prostrate legumes are 6 to 8 inches high; (2) stop grazing when the soil is wet; (3) graze the fields in strips to allow plants to recover; (4) remove animals when most of the plants have been grazed to a height of 2 inches; (5) clip pasture if the pasture has been unevenly grazed or if tall grass is left in bunches that may smother the legumes; (6) do not graze legume pastures between September 1 and October 10; and (7) topdress using the kind and amount of fertilizer needed as indicated by soil tests.

Good management of perennial pasture plants will also provide high quality forage and maintain plant vigor. Suitable management practices for perennial pasture are: (1) lime and fertilize according to soil tests; (2) remove stones and other obstructions; (3) delay grazing when the soils are wet; (4) avoid overgrazing; and (5) if the pasture plants are not high quality, reseed with desirable plants and use management practices suitable for rotation pasture.

Information for growing pasture plants can be obtained from the local offices of the University of Wisconsin, Extension Service, and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the soil is not suited to the crop or the crop is not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents (*5*). Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 4.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the University of Wisconsin, Extension Service, can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops (*9*). The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is indicated in table 5. All soils in the survey area except some named at a level higher than the series and those in miscellaneous areas are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

The capability subclass is identified in the description of each soil map unit in the section "Soil maps for detailed planning."

Woodland management and productivity

George W. Alley, forester, Soil Conservation Service, helped prepare this section.

All of Calumet and Manitowoc Counties was woodland before settlement (*3*). The settlers cleared most of this woodland for use as cropland. Now about 13 percent of Calumet County and about 16 percent of Manitowoc County is woodland (*14*). Nearly all of this woodland is used for commercial production. Most of this commercial woodland is in small tracts owned by farmers who supplement their income by harvesting hardwood pulpwood and sawlogs. Most of the woodland in the survey area is more valuable as recreation areas, wildlife habitat, and watershed than as commercial woodland.

In Calumet County the timber types, by percent of total woodland area, are: oak-hickory, 28 percent; maple-beech-birch, 26 percent; elm-ash-cottonwood, 25 percent; aspen-birch, 11 percent; conifers, 6 percent; and nonstocked 4 percent. The Manitowoc County stand is 32 percent maple-beech-birch, 24 percent elm-ash-cottonwood, 18 percent oak-hickory, 12 percent aspen-birch, 11 percent conifers, and 3 percent nonstocked.

Table 6 contains information useful to woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general kinds of woodland management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and r.

In table 6 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings. Plant competition is not considered in the ratings. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate*, that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Important trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 7 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 7, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from the Soil Conservation Service, the Cooperative Extension Service, nurserymen, or the Wisconsin Department of Natural Resources forester.

Engineering

Peg S. Whiteside, soil mechanics engineer, Soil Conservation Service, helped prepare this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. If pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 feet. Also, because of the large scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil are included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 8 shows, for each kind of soil, the degree and kind of limitations for building site development; table 9, for sanitary facilities; and table 11, for water management. Table 10 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitation that affects shallow excavations, dwellings with and without a basement, small commercial buildings, local roads and streets, and lawns and landscaping are indicated in table 8. A *slight* limitation indicates that soil properties generally are favorable for the specified use and that limitations are minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils that are rated severe, costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 5 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Potential frost action was not considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil, as well as the quantity and workability of fill material available, are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Lawns and landscaping require soils that are suitable for the establishment and maintenance of turf for lawns and ornamental trees and shrubs for landscaping. The best soils are firm after rains, are not dusty when dry, and absorb water readily and hold sufficient moisture for plant growth. The surface layer should be free of stones. If shaping is required, the soils should be thick enough over bedrock or hardpan to allow for necessary grading. In rating the soils, the availability of water for sprinkling is assumed.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special design, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, and *poor*, which mean about the same as *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 60 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table, by creating a filtering mound over wet or impervious soil or soil underlain by bedrock, can be installed; or the size of the absorption field can be increased so that performance is satisfactory. Local or state ordinances that control construction should be referred to.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 9 apply only to the soil material within a depth of about 5 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

If it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the site should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction material. Each soil is evaluated to the depth observed, generally about 5 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low frost action potential, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 5 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel or stones.

Soils rated *poor* are very sandy soils or very firm clayey soils, soils that have suitable layers less than 8 inches thick, soils that have large amounts of gravel or stones, steep soils, and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 11 the site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of the soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 11 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 12 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 8.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They have moderate slopes and have few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have a surface that is free of stones and boulders and have moderate slopes. Suitability of the soil for traps, tees, or greens was not considered in rating the soils. Irrigation is an assumed management practice.

Wildlife habitat

Steve F. Baima, biologist, Soil Conservation Service, helped prepare this section.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

In table 13, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of habitat are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are indiangrass, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of hardwood plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

The essential habitat elements of a selected species of wildlife generally depend on several kinds of soil and commonly a combination of land uses. For this reason, the map units described in the section "General soil map for broad land-use planning" are grouped into four wildlife areas.

In the following paragraphs, the map units of Calumet and Manitowoc Counties are described as wildlife areas.

These areas differ in regard to wildlife species that inhabit the areas and potential for wildlife habitat development. In the survey area the value of each wildlife area depends on its interspersion with the other areas, and the diversity of wildlife depends on the diversity of soils, land uses, and management of all of the wildlife areas.

Wildlife area 1. This wildlife area is on the Kewaunee-Manawa-Poygan, Hortonville-Symco, Hochheim-Lamartine-Mayville, Zurich-Mundelein-Briggsville, Pella-Mundelein-Shiocton, and Channahon-Whalan-Kolberg map units. This wildlife area is larger than the other three wildlife areas combined. The soils range from nearly level to moderately steep and from well drained to poorly drained. Growing general farm and specialty crops is the dominant land use. This wildlife area can be divided on the basis of spring and fall plowing significantly affecting wildlife. Soils in the Kewaunee-Manawa-Poygan, Zurich-Mundelein-Briggsville, and Pella-Mundelein-Shiocton map units are generally fall plowed, reducing winter cover to fence rows, scattered woodlots, and adjacent wildlife areas. Soils in the Hortonville-Symco, Hochheim-Lamartine-Mayville, and Channahon-Whalan-Kolberg map units generally are fall plowed less, and crop residue and waste grain provide important winter food and cover in addition to that provided by many small, wooded areas.

Much of this area is artificially drained, so natural wetlands are not common except for low-lying areas along major watercourses. Although they are too numerous to map, these wetlands, interspersed with agricultural land, provide the diversity needed by many game and nongame species of wildlife. Major game species in the area include pheasants, Hungarian partridge, white-tailed deer, Wilson's snipe, woodcock, wood ducks, mallards, and blue-winged teal.

The soils in this wildlife area have good potential for habitat development. Many areas are suitable for ponds. Hardwood trees and shrubs grow well on these soils as do cultivated crops.

Wildlife area 2. This wildlife area is on the Kewaunee-Boyer-Nichols and the Hochheim-Lutzke map units. The soils range from gently sloping to steep and are mostly well drained. The steeper slopes are mostly wooded, and the lesser slopes are mainly cropland. Plowing is done in the spring and fall, leaving some crop residue available to wildlife for winter food and cover. The Hochheim-Lutzke map unit includes large wooded areas, whereas the Kewaunee-Boyer-Nichols map unit includes small, scattered woodlots.

Wildlife habitat diversity is rated high in this area because cropland and wooded areas are well interspersed. Major game and furbearer species include white-tailed deer, gray and fox squirrels, cottontail rabbit, ruffed grouse, gray and red fox, and raccoon.

The soils in wildlife area 2 have good potential for development of habitat for upland wildlife. Hardwood trees and shrubs grow well on these soils as do cultivated crops.

Wildlife area 3. This wildlife area is on the Wasepi-Plainfield-Boyer and the Granby-Oakville-Tedrow map units. The soils range from nearly level to sloping and from excessively drained to poorly drained. Though this area is mostly wooded, some row crops are grown. Pine plantings are common. The main soils are droughty, limiting the growth of plants and hence the production of food for wildlife.

Major game species inhabiting the area include white-tailed deer, squirrel, and ruffed grouse. Furbearers such as muskrat and otter use the wetlands along the major drainageways and scattered potholes. Large tracts planted to pines provide little benefit to wildlife except for occasional winter cover and some nesting by species such as the mourning dove.

The soils in this wildlife area have fair to poor potential for the development of wildlife habitat. Wetland habitat development and dugout pond construction are mostly limited to minor soils and depend on the fluctuating levels of ground water.

Wildlife area 4. This wildlife area is on the Houghton-Palms-Willette map unit. The soils are nearly level and very poorly drained. This wildlife area is mostly wetland and is mainly along major drainageways. Fresh meadows, shallow marshes, shrub swamps, and wooded swamps are the most common types of wetland habitat (*7*). Scattered deep water marshes and open water wetlands make up a smaller acreage.

Wood ducks, mallards, and blue-winged teal use this area extensively as do furbearers such as muskrat, mink, otter, and raccoon. Many nongame species, particularly birds and reptiles, are also quite common in the area.

The soils, topography, and hydrologic conditions in this wildlife area provide excellent opportunity for development of habitat for wetland wildlife. Dugout ponds, level ditches, and shallow water developments can be constructed to increase the amount of open water. Much of this area has a high wildlife value in its present state.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features and engineering test data.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area is given in table 17. The estimated classification is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and in plasticity index is estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems. In table 15, it is expressed as inches of water per inch of soil.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Subsidence is the settlement of organic soils or of soils containing semifluid layers. Initial subsidence generally results from drainage. Total subsidence is initial subsidence plus the slow sinking that occurs over a period of several years as a result of the oxidation or compression of organic material.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 17.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by the Wisconsin Department of Transportation, Division of Highways.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The codes for shrinkage and Unified classification are those assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-66); Unified classification (D-2487-69); mechanical analysis (T88-57); liquid limit (T89-60); plasticity index (T90-56); and moisture-density, method A (T99-57).

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*10*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid climate, plus *alf*, from Alfisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Hapludalf (*Hapl*, meaning simple horizons, plus *udalf*, the suborder of Alfisols that have a udic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine, mixed, mesic, Typic Hapludalfs.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*8*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Adrian series

The Adrian series consists of very poorly drained, moderately rapidly permeable soils in depressions in old glacial lake basins. These soils formed in 16 to 50 inches of muck over sand. Slopes range from 0 to 2 percent.

Adrian soils are adjacent on the landscape to Granby and Oakville soils. Granby soils are sandy and poorly drained; they are in slightly higher positions on the landscape. Oakville soils are sandy and well drained; they are on convex side slopes and are in higher positions on the landscape.

Typical pedon of Adrian muck, 940 feet east and 1,280 feet north of SW corner of sec. 22, T. 20 N., R. 24 E. (in Manitowoc County):

Oa1—0 to 12 inches; black (5YR 2/1) broken face, rubbed, and pressed sapric material; about 12 percent fiber, 3 percent rubbed; weak fine subangular blocky structure; nonsticky; many roots; neutral; clear wavy boundary.

Oa2—12 to 40 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material, dark reddish brown (5YR 3/2) pressed; about 20 percent fiber, 7 percent rubbed; weak coarse subangular blocky structure; nonsticky; common roots; about 10 percent woody fragments more than 10 millimeters in diameter; few lenses of dark reddish brown (5YR 3/3) broken face; neutral; clear wavy boundary.

IIC—40 to 60 inches; brown (10YR 5/3) sand; single grained; loose; mildly alkaline.

The organic layer is 16 to 50 inches thick. The sapric material has value of 2 or 3 and chroma of 0 to 3. In some places thin layers of hemic material less than 5 inches thick are in the subsurface tier. The IIC horizon has value of 5 or 6 and chroma of 2 or 3. It is fine sand, sand, or sand and gravel. The higher chroma of the parent material is due to the color of uncoated sand grains.

Bellevue series

The Bellevue series consists of moderately well drained, moderately permeable soils on flood plains. These soils formed in loamy alluvial deposits. Slopes range from 0 to 3 percent.

Bellevue soils are commonly adjacent to Boyer and Wasepi soils and Fluvaquents on the landscape. Boyer soils are well drained; they have a sand and gravel C horizon and are in slightly higher positions on terraces. Fluvaquents are poorly drained; they are below the Bellevue soils on the landscape. Wasepi soils are somewhat poorly drained; they are in slightly lower positions on terraces and in drainageways.

Typical pedon of Bellevue silt loam, 0 to 3 percent slopes, 2,000 feet south and 1,170 feet west of NE corner of sec. 5, T. 20 N., R. 20 E. (in Calumet County):

A1—0 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; many roots; mildly alkaline; abrupt wavy boundary.

B1—11 to 15 inches; reddish brown (5YR 4/3) loam; weak fine subangular blocky structure; friable; few roots; slight effervescence; mildly alkaline; clear wavy boundary.

B2—15 to 23 inches; reddish brown (5YR 4/3) loam; weak medium subangular blocky structure; friable; few fine prominent dark reddish gray (5YR 4/2) organic stains; slight effervescence; mildly alkaline; clear wavy boundary.

B3—23 to 35 inches; reddish brown (5YR 4/3) loam; common fine prominent yellowish red (5YR 4/8) mottles; weak coarse subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C—35 to 60 inches; dark reddish brown (5YR 3/4) loam; common fine prominent yellowish red (5YR 4/8) mottles; massive; few fine distinct dark reddish gray (5YR 4/2) organic stains; mildly alkaline.

The solum is 25 to 45 inches thick. The depth to free carbonates is 10 to 30 inches.

The A horizon has value of 2 or 3 and chroma of 2 or 3. It is dominantly loam, but the range includes very fine sandy loam. The A horizon is 10 to 14 inches thick. The B horizon has chroma of 3 or 4. It is loam, sandy clay loam, or sandy loam. Mottles are between depths of 20 and 40 inches. There are thin lenses of sand and organic stains throughout the B horizon in some pedons.

Boyer series

The Boyer series consists of well drained soils on moraines, outwash plains, and terraces. These soils are moderately rapidly permeable in the subsoil and very rapidly permeable in the substratum. They formed in loamy deposits underlain by outwash sand and gravel. Slopes range from 2 to 25 percent.

Boyer soils are commonly adjacent to Lutzke, Plainfield, and Wasepi soils on the landscape. Lutzke soils are well drained; they are in similar positions on the landscape but have more gravel. Plainfield soils are sandy and excessively drained; they are in similar positions on the landscape but do not have an argillic horizon. Wasepi soils are somewhat poorly drained; they are in shallow depressions and drainageways.

Typical pedon of Boyer sandy loam, 2 to 6 percent slopes, 2,010 feet south and 1,740 feet east of NW corner of sec. 23, T. 20 N., R. 23 E. (in Manitowoc County):

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many roots; neutral; abrupt smooth boundary.

A2—6 to 9 inches; pale brown (10YR 6/3) sandy loam; weak thick platy structure parting to weak fine subangular blocky; friable; many roots; neutral; clear wavy boundary.

B1t—9 to 16 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common roots; thin discontinuous clay films; estimated 12 percent gravel; neutral; clear wavy boundary.

B2t—16 to 21 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; friable; common roots; moderately thick continuous clay films; estimated 12 percent gravel; 4 percent cobblestones; neutral; clear wavy boundary.

B3t—21 to 29 inches; brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; very friable; few roots; clay bridging; estimated 20 percent gravel; 2 percent cobblestones; mildly alkaline; clear wavy boundary.

C—29 to 60 inches; yellowish brown (10YR 5/4) stratified sand and gravel; single grained; loose; estimated 45 percent gravel; 10 percent cobblestones; violent effervescence; mildly alkaline.

The solum is 24 to 37 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4. Soils in uncultivated areas have an A1 horizon that has chroma of 1 or 2. The A1 horizon is dominantly sandy loam, but the range includes loamy sand. It is 3 to 5 inches thick. The A2 horizon has value of 5 or 6. It is sandy loam or loamy sand. The B1t horizon has chroma of 3 or 4. It is sandy loam or loamy sand. The B2t horizon is gravelly sandy clay loam or sandy loam. The B3t horizon is gravelly sandy loam or sandy loam. Coarse fragments make up 5 to 20 percent of the B horizon and 5 to 50 percent of the C horizon. The C horizon is mostly sand and gravel but is stratified silt and very fine sand in some pedons.

Briggsville series

The Briggsville series consists of well drained and moderately well drained, moderately slowly permeable soils in glacial lake basins and on side slopes of drainageways. These soils formed in water-laid sediment. Slopes range from 2 to 12 percent.

These soils have interfingering of albic material into the argillic horizon, which is not defined in the range of the series. This difference does not affect use and management of these soils.

Briggsville soils are adjacent on the landscape to Manawa and Nichols soils. Manawa soils are somewhat poorly drained; they are in lower positions on the landscape in shallow depressions and drainageways. Nichols soils are well drained and moderately well drained; they are in similar positions on the landscape but have a coarser textured B horizon.

Typical pedon of Briggsville silt loam, 2 to 6 percent slopes, 2,640 feet west and 2,000 feet south of NE corner of sec. 18, T. 19 N., R. 24 E. (in Manitowoc County):

Ap—0 to 6 inches; dark brown (10YR 3/3) silt loam, light gray (10YR 7/2) dry; weak medium subangular blocky structure parting to weak medium granular; friable; many roots; neutral; abrupt smooth boundary.

B&A—6 to 10 inches; reddish brown (5YR 4/3) silt loam (Bt; 75 percent); moderate medium subangular blocky structure; friable; common roots; thin discontinuous clay films on faces of peds; interfingers of pale brown (10YR 6/3) silt loam (A2; 25 percent) 5 to 10 millimeters in diameter extend through this horizon; neutral; clear wavy boundary.

B21t—10 to 16 inches; reddish brown (5YR 4/4) silty clay loam; moderate medium and fine subangular blocky structure; friable; common roots; thin continuous clay films on faces of peds; neutral; clear wavy boundary.

B22t—16 to 21 inches; reddish brown (5YR 4/3) silty clay; weak thick platy structure parting to moderate medium subangular blocky; firm; common roots; thin continuous clay films on faces of peds; neutral; clear wavy boundary.

B3t—21 to 31 inches; reddish brown (5YR 4/3) silty clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

C—31 to 60 inches; reddish brown (5YR 4/3) and very pale brown (10YR 7/3) stratified silt loam, silty clay loam, and fine sandy loam; few fine prominent yellow (10YR 7/6) mottles; weak thick platy structure; friable; slight effervescence; mildly alkaline.

The solum is 24 to 40 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has chroma of 2 or 3; it has value higher than 5.5 when dry. Soils in uncultivated areas have a 3- to 5-inch A1 horizon that has value of 2 or 3 and chroma of 1 or 2 and a 2- to 4-inch A2 horizon that has value of 4 to 6 and chroma of 2 or 3. The B&A horizon is 3 to 6 inches thick. The B2t horizon is dominantly heavy silty clay loam; some pedons have thin horizons of heavy silt loam or silty clay.

Brookston series

The Brookston series consists of very poorly drained, moderately permeable or moderately slowly permeable soils in depressions and broad drainageways on till plains. These soils formed in silty deposits and in the underlying loamy glacial till. Slopes range from 0 to 2 percent.

These soils have redder B3 and C horizons and have a thinner solum than that defined in the range of the series, but these differences do not affect use and management of these soils.

Brookston soils are associated with Pella and Symco soils on the landscape. Pella soils are poorly drained; they do not have an argillic horizon, and they are in similar positions on the landscape. Symco soils are somewhat poorly drained; they are in slightly higher positions on the landscape.

Typical pedon of Brookston silt loam, 1,500 feet south and 1,360 feet east of NW corner of sec. 31, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 12 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak fine and medium granular; friable; many roots; neutral; abrupt smooth boundary.

B2tg—12 to 19 inches; dark gray (10YR 4/1) clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few roots; thin discontinuous clay films on faces of peds; estimated 2 percent gravel; mildly alkaline; clear wavy boundary.

B3—19 to 25 inches; brown (7.5YR 5/4) loam; common medium distinct strong brown (7.5YR 5/6) and common fine distinct brown (7.5YR 5/2) mottles; weak coarse subangular blocky structure; very friable; few roots; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

C—25 to 60 inches; brown (7.5YR 5/4) loam; few fine prominent strong brown (7.5YR 5/8) mottles; massive; very friable; estimated 4 percent gravel; slight effervescence; mildly alkaline.

The solum is 24 to 30 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A horizon is 11 to 13 inches thick. It has chroma of 1 or 2. The B2tg horizon has value of 4 to 6 and chroma of 1 or 2. It is dominantly clay loam and has transitional or thin horizons of loam and silty clay loam. The B3 horizon has value of 4 to 6 and chroma of 4 to 6. It is dominantly loam, but some pedons have thin subhorizons of clay loam. Gravel makes up 2 to 4 percent of this horizon.

Channahon series

The Channahon series consists of shallow, well drained, moderately permeable soils on glaciated bedrock-controlled uplands. These soils formed in loamy deposits over dolomite. Slopes range from 2 to 12 percent.

Channahon soils are similar to Whalan soils and are commonly adjacent to Hochheim soils. Whalan soils are well drained; they are in similar positions on the landscape but have a thicker solum above dolomite than Channahon soils. Hochheim soils are well drained; they are on till plains and do not have dolomite within 60 inches of the surface.

Typical pedon of Channahon loam, 2 to 6 percent slopes, 2,280 feet north and 2,200 feet west of SE corner of sec. 26, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common roots; estimated 5 percent gravel; neutral; abrupt smooth boundary.

B2t—8 to 14 inches; dark brown (7.5YR 4/4) clay loam; weak fine subangular blocky structure; friable; common roots; thin continuous clay films on faces of peds; estimated 8 percent gravel; mildly alkaline; clear wavy boundary.

B3—14 to 18 inches; light brown (7.5YR 6/4) clay loam; weak fine subangular blocky structure; friable; estimated 10 percent gravel; mildly alkaline; abrupt wavy boundary.

R—18 inches; white (5Y 8/1) dolomite; slight effervescence.

The solum is 10 to 20 inches thick. The depth to dolomite corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2 or 3. Soils in uncultivated areas have a 5- to 7-inch A1 horizon that has value of 2 or 3 and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam. The B2t horizon is heavy loam, sandy clay loam, or light clay loam. Some pedons have thin or transitional horizons of silty clay loam. The B3 horizon is dominantly light clay loam and has thin or transitional horizons of sandy loam. Coarse fragments throughout the solum range from 5 to 10 percent. The R horizon is fractured in the upper few inches. The fractures are smaller and fewer in number with an increase in depth. Clay residuum fills the fractures in some areas.

Cosad series

The Cosad series consists of somewhat poorly drained soils in drainageways on glacial lake plains and till plains. These soils are rapidly permeable in the solum and slowly permeable in the substratum. They formed in sandy outwash over clayey till or lacustrine deposits. Slopes range from 0 to 3 percent.

These soils have a cambic horizon, which is outside the defined range of the series, but this difference does not affect use and management of these soils.

Cosad soils are adjacent on the landscape to Tedrow, Tustin, and Wauseon soils. Tedrow soils are somewhat poorly drained; they are in similar positions on the landscape but have a fine sand substratum. Tustin soils are well drained; they are in higher positions on the landscape. Wauseon soils are very poorly drained; they are in lower positions on the landscape.

Typical pedon of Cosad loamy fine sand, 0 to 3 percent slopes, 1,820 feet east and 2,030 feet south of NW corner of sec. 20, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 9 inches; very dark brown (10YR 2/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium granular structure; very friable; common roots; neutral; abrupt smooth boundary.

B21—9 to 13 inches; dark yellowish brown (10YR 4/4) loamy sand; common medium prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; very friable; few roots; neutral; clear wavy boundary.

B22—13 to 18 inches; dark yellowish brown (10YR 4/4) loamy sand; common large prominent yellowish brown (10YR 5/8) and common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; very friable; few roots; neutral; clear wavy boundary.

B23—18 to 26 inches; brown (10YR 5/3) medium and coarse sand; common large prominent strong brown (7.5YR 5/8) and common fine faint grayish brown (10YR 5/2) mottles; single grained; very friable; few roots; neutral; abrupt wavy boundary.

IIB24—26 to 30 inches; reddish brown (5YR 5/4) silty clay; common medium prominent yellowish red (5YR 5/8) and few fine distinct reddish gray (5YR 5/2) mottles; moderate fine subangular blocky structure; firm; few roots; neutral; clear wavy boundary.

IIC—30 to 60 inches; reddish brown (5YR 5/4) silty clay; common coarse prominent yellowish red (5YR 5/8) and few fine distinct reddish gray (5YR 5/2) mottles; massive; strong effervescence; mildly alkaline.

The solum is 24 to 36 inches thick. Typically, free carbonates are at a depth of 32 to 34 inches, but the range is 24 to 36 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes loamy sand. The upper part of the B2 horizon is loamy sand and has thin horizons of sand, loamy fine sand, or sandy loam in some pedons. Some pedons have a 1- to 3-inch horizon of sandy loam, loam, or sandy clay loam above the IIB24 horizon. The IIB24 horizon is silty clay or clay. The IIC horizon is silty clay or clay.

Dodge series

The Dodge series consists of well drained, moderately permeable soils on drumlins and ground moraines. These soils formed in silty deposits and in the underlying glacial till. Slopes range from 2 to 6 percent.

These soils have a darker colored surface layer than that defined in the range of the series, but this difference does not affect use and management of these soils.

Dodge soils are similar to Mayville soils and are commonly adjacent to Theresa soils on the landscape. Mayville soils are moderately well drained; they are in slightly lower positions on concave side slopes. Theresa soils are well drained; they are in slightly higher positions on the landscape and have a thinner silty mantle.

Typical pedon of Dodge silt loam, 2 to 6 percent slopes, 1,880 feet north and 10 feet east of SW corner of sec. 21, T. 17 N., R. 20 E. (in Calumet County):

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1—6 to 8 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

B21t—8 to 11 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; common roots; thin discontinuous clay films on faces of peds; neutral; clear wavy boundary.

B22t—11 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; common roots; thin discontinuous clay films on faces of peds; neutral; clear wavy boundary.

B23t—20 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; friable; few roots; thin discontinuous clay films on faces of peds; neutral; clear wavy boundary.

IIB24t—31 to 33 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; few roots; thin continuous clay films on faces of peds; estimated 5 percent fine gravel; neutral; clear wavy boundary.

IIB3t—33 to 37 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium subangular blocky structure; friable; few roots; moderately thick discontinuous clay films on faces of peds; estimated 7 percent gravel; neutral; clear wavy boundary.

IIC—37 to 60 inches; light yellowish brown (10YR 6/4) loam; massive; very friable; estimated 14 percent gravel; slight effervescence; mildly alkaline.

The solum is 30 to 40 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2. Soils in uncultivated areas have a 4- or 5-inch A1 horizon that has value of 2 and chroma of 1 or 2 and a 2- or 3-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is 18 to 28 inches thick. The IIB2t horizon and IIB3t horizon have 1 to 10 percent gravel. The IIC horizon is dominantly calcareous loam, but in some small areas it is gravelly loam or sandy loam.

Granby series

The Granby series consists of poorly drained, rapidly permeable soils in depressions and drainageways on outwash plains and old beaches. These soils formed in sandy glaciofluvial deposits. Slopes range from 0 to 2 percent.

Granby soils are adjacent on the landscape to Adrian and Tedrow soils. Adrian soils are very poorly drained; they are in slightly lower positions on the landscape and have a muck surface layer that is 16 to 50 inches thick. Tedrow soils are somewhat poorly drained; they are in a slightly higher position on the landscape.

Typical pedon of Granby fine sandy loam, 1,300 feet east and 300 feet north of SW corner of sec. 35, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many roots; neutral; abrupt smooth boundary.

B2—10 to 12 inches; brown (10YR 5/3) loamy fine sand; many coarse prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; mildly alkaline; abrupt wavy boundary.

B3—12 to 36 inches; light yellowish brown (10YR 6/4) fine sand; common medium distinct grayish brown (10YR 5/2) mottles; single grained; loose; mildly alkaline; clear wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) fine sand; common coarse prominent yellowish brown (10YR 5/6) mottles; single grained; loose; mildly alkaline.

The solum is 24 to 42 inches thick.

The A horizon is 10 to 12 inches thick. The B2 horizon has value of 5 or 6 and chroma of 3. The higher chroma is due to the color of uncoated sand grains. The B2 horizon is loamy fine sand, loamy sand, fine sand, or sand. The C horizon is fine sand or sand.

Hochheim series

The Hochheim series consists of well drained, moderately permeable or moderately slowly permeable soils on drumlins and ground moraines. These soils formed in loamy glacial till. Slopes range from 2 to 25 percent.

These soils have a lighter colored surface layer than that defined in the range of the series, but this difference does not affect use and management of these soils.

Hochheim soils are adjacent on the landscape to Boyer and Symco soils. Boyer soils are well drained; they are in similar positions on the landscape but are underlain by sand and gravel. Symco soils are somewhat poorly drained; they are on concave side slopes and in drainageways.

Typical pedon of Hochheim loam, 2 to 6 percent slopes, 610 feet south and 1,420 feet east of NW corner of sec. 11, T. 18 N., R. 19 E. (in Calumet County):

Ap—0 to 7 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; mildly alkaline; abrupt smooth boundary.

B1t—7 to 11 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; few thin patchy clay films on some faces of peds; estimated 3 percent gravel; mildly alkaline; clear wavy boundary.

B2t—11 to 18 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; friable; moderately thick continuous clay films on faces of peds; estimated 3 percent gravel; mildly alkaline; clear wavy boundary.

B3t—18 to 21 inches; dark yellowish brown (10YR 4/4) loam; weak coarse subangular blocky structure; friable; few thin patchy clay films on faces of peds; estimated 6 percent gravel; mildly alkaline; abrupt wavy boundary.

C—21 to 60 inches; light yellowish brown (10YR 6/4) gravelly loam; massive; friable; estimated 20 percent gravel and 5 percent cobblestones; slight effervescence; mildly alkaline.

The solum is 14 to 24 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 2 and chroma of 1 or 2 and a 3- or 4-inch A2 horizon that has value of 5 or 6 and chroma of 3 or 4. These horizons are dominantly loam, but some pedons have thin layers of silt loam. The B2t horizon has hue of 7.5YR or 10YR and is 6 to 8 inches thick. The B3t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam, heavy loam, or sandy loam. The content of gravel in the solum ranges from 0 to 10 percent; the highest percentage is in the lower part of the argillic horizon. The C horizon is calcareous gravelly sandy loam or gravelly loam. The content of cobblestones in this horizon ranges from 0 to 10 percent.

Hortonville series

The Hortonville series consists of well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in silty deposits and in the underlying glacial till. Slopes range from 2 to 20 percent.

Hortonville soils are adjacent to Kewaunee, Symco, and Waymor soils on the landscape. Kewaunee soils are well drained; they are in similar positions on the landscape but have finer textured B and C horizons. Symco soils are somewhat poorly drained; they are on concave side slopes and in drainageways. Waymor soils are well drained; they are in similar positions on the landscape but have a coarser textured substratum.

Typical pedon of Hortonville silt loam, 2 to 6 percent slopes, 1,890 feet west and 980 feet north of SE corner of sec. 32, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; few roots; estimated 4 percent gravel; mildly alkaline; abrupt smooth boundary.

B&A—7 to 13 inches; dark brown (7.5YR 4/4) loam (Bt); weak very fine subangular blocky structure; friable; thin discontinuous clay films on faces of peds in Bt part; about 35 percent, by volume, interfingers of brown (10YR 5/3) silt loam (A2) extend through this horizon; few roots; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

B2t—13 to 20 inches; reddish brown (5YR 4/4) clay loam; moderate fine subangular blocky structure; friable; few roots; thin continuous clay films on faces of peds; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

B3t—20 to 25 inches; reddish brown (5YR 4/4) loam; weak medium subangular blocky structure; friable; few roots; thin discontinuous clay films on vertical faces of peds; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

C—25 to 60 inches; reddish brown (5YR 5/4) loam; massive; friable; estimated 7 percent gravel and 2 percent cobblestones; strong effervescence; mildly alkaline.

The solum is 24 to 30 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- to 5-inch A1 horizon that has value of 3 and chroma of 1 or 2 and a 3- to 4-inch A2 horizon that has value of 5 or 6 and chroma of 2 or 3. These horizons are dominantly silt loam and have thin or transitional layers of loam. The B&A horizon is 4 to 8 inches thick. The B2t horizon is dominantly clay loam and has transitional or thin layers of loam or silty clay loam. The content of gravel in the lower part of the B horizon and in the C horizon ranges from 4 to 12 percent. The C horizon is dominantly loam, but some pedons have thin or transitional subhorizons of clay loam or silty clay loam.

Houghton series

The Houghton series consists of very poorly drained, moderately rapidly permeable soils in depressions in glacial lake basins. These soils formed in more than 51 inches of highly decomposed organic material. Slopes range from 0 to 2 percent.

Houghton soils are adjacent to Adrian, Palms, and Willette soils on the landscape. Adrian, Palms, and Willette soils are very poorly drained organic soils; they are in similar positions on the landscape but are underlain by mineral soil within a depth of 51 inches.

Typical pedon of Houghton muck, 1,380 feet south and 480 feet west of NE corner of sec. 5, T. 20 N., R. 25 E. (in Manitowoc County):

Oal—0 to 30 inches; black (10YR 2/1) broken face sapric material, very dark brown (10YR 2/2) rubbed, very dark gray (10YR 3/1) pressed; about 15 percent fiber, less than 5 percent rubbed; weak coarse granular structure; nonsticky; many roots; slightly acid; abrupt wavy boundary.

Oa2—30 to 36 inches; dark yellowish brown (10YR 3/4) broken face sapric material, very dark brown (10YR 2/2) rubbed, very dark grayish brown (10YR 3/2) pressed; about 20 percent fiber, 12 percent rubbed; massive; nonsticky; few roots; medium acid; abrupt wavy boundary.

Oa3—36 to 60 inches; black (10YR 2/1) broken face sapric material, very dark brown (10YR 2/2) rubbed and pressed; massive; nonsticky; medium acid.

The organic material is more than 51 inches thick. It is dominantly sapric, but thin layers of hemic and fibric material are in the subsurface tier of some pedons.

Keowns series

The Keowns series consists of poorly drained, moderately permeable soils in depressions in glacial lake basins. These soils formed in lacustrine deposits of very fine sandy loam. Slopes range from 0 to 2 percent.

These soils have a slightly thicker surface layer than that defined in the range of the series, but this difference does not affect use and management of these soils.

Keowns soils are adjacent on the landscape to Granby, Palms, and Pella soils. Granby soils are poorly drained; they are in similar positions on the landscape but are coarser textured throughout. Palms soils are very poorly drained organic soils; they are in lower positions on the landscape in wet depressions. Pella soils are poorly drained; they are in similar positions on the landscape but are finer textured throughout.

Typical pedon of Keowns very fine sandy loam, 180 feet north and 520 feet west of SE corner of sec. 31, T. 21 N., R. 22 E. (in Manitowoc County):

Ap—0 to 13 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

B2—13 to 20 inches; pale brown (10YR 6/3) very fine sandy loam; weak medium platy structure; friable;

slight effervescence; mildly alkaline; clear wavy boundary.

B3—20 to 29 inches; brown (10YR 5/3) very fine sandy loam; common medium prominent yellowish brown (10YR 5/6) and common medium faint grayish brown (2.5Y 5/2) mottles; weak thick platy structure; friable; slight effervescence; mildly alkaline; clear wavy boundary.

C1—29 to 48 inches; brown (10YR 5/3) very fine sandy loam; common large distinct dark yellowish brown (10YR 3/4) and common large prominent yellowish brown (10YR 5/8) mottles; massive; slight effervescence; mildly alkaline; clear wavy boundary.

C2—48 to 54 inches; grayish brown (10YR 5/2) very fine sandy loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; friable; slight effervescence; mildly alkaline; abrupt wavy boundary.

IIC—54 to 60 inches; light yellowish brown (10YR 6/4) fine and medium sand; single grained; loose; slight effervescence; mildly alkaline.

The solum is 24 to 32 inches thick. Free carbonates are in the surface layer in most pedons; in some pedons there are no free carbonates above a depth of 12 inches.

The B horizon is dominantly very fine sandy loam and has thin layers of silt loam, loamy very fine sand, or very fine sand in some pedons. The C horizon above a depth of 40 inches is dominantly very fine sandy loam and has thin layers of silt loam and very fine sand in some pedons. The C horizon below a depth of 40 inches is dominantly very fine sandy loam, but layers of fine and medium sand are in some pedons. The higher chroma of the parent material is due to the color of uncoated sand grains.

Kewaunee series

The Kewaunee series consists of well drained, slowly permeable soils on glacial till uplands. These soils formed in thin loamy deposits and in clayey glacial till. Slopes range from 2 to 30 percent.

Kewaunee soils are adjacent on the landscape to Hortonville, Kolberg, Lutzke, and Manawa soils. Hortonville soils are well drained; they are in similar positions on the landscape but have less clay in the B and C horizons. Kolberg soils are well drained and have lithic contact at a depth of 20 to 40 inches. Lutzke soils are well drained; they formed in gravelly outwash. Manawa soils are somewhat poorly drained; they are on concave side slopes and in drainageways.

Typical pedon of Kewaunee loam, 2 to 6 percent slopes, 2,520 feet east and 75 feet south of NW corner of sec. 24, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 8 inches; dark brown (7.5YR 3/2) loam, pinkish gray (7.5YR 6/2) dry; moderate fine granular structure; friable; common roots; estimated 3 percent gravel; neutral; abrupt smooth boundary.

B1t—8 to 12 inches; reddish brown (5YR 4/4) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous clay films on faces of peds; estimated 2 percent gravel; neutral; clear wavy boundary.

B2t—12 to 18 inches; reddish brown (5YR 4/4) clay; moderate fine subangular blocky structure; firm; few roots; moderately thick continuous clay films on faces of peds; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

B3t—18 to 23 inches; reddish brown (5YR 4/4) clay; moderate fine subangular blocky structure; few roots; thin discontinuous clay films on faces of peds; estimated 6 percent gravel; mildly alkaline; clear wavy boundary.

C—23 to 60 inches; reddish brown (5YR 5/4) clay; massive; firm; estimated 6 percent gravel; free lime coatings in cracks and crevices; strong effervescence; mildly alkaline.

The solum is 20 to 36 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has hue of 10YR to 7.5YR, value of 3 or 4, and chroma of 2 or 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 2 or 3 and chroma of 1 or 2 and a 2- or 3-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. These horizons are dominantly loam and have thin or transitional layers of sandy loam or silt loam. The B1t horizon has hue of 7.5YR or 5YR and is clay loam or silty clay loam. The B2t and B3t horizons are clay or silty clay. The C horizon is silty clay loam, silty clay, or clay. Gravel in the lower part of the B horizon and in the C horizon ranges from 5 to 10 percent.

Kolberg series

The Kolberg series consists of well drained, moderately slowly permeable or slowly permeable soils on glaciated bedrock-controlled uplands. These soils formed in clayey glacial till over dolomite. Slopes range from 2 to 12 percent.

These soils have a slightly warmer soil temperature than that defined in the range of the series, but this difference does not affect use and management of these soils.

Kolberg soils are adjacent on the landscape to Channahon and Kewaunee soils. Channahon soils are well drained; they are in similar positions on the landscape as Kolberg soils but have a thinner solum over dolomite and do not have the clayey B horizon. Kewaunee soils are well drained; they are in similar positions on the landscape as Kolberg soils but do not have lithic contact within 60 inches of the surface.

Typical pedon of Kolberg loam, 2 to 6 percent slopes, 2,620 feet south and 1,420 feet west of NE corner of sec. 3, T. 19 N., R. 20 E. (in Calumet County):

Ap—0 to 8 inches; dark brown (7.5YR 3/2) loam, pinkish gray (7.5YR 6/2) dry; weak fine subangular blocky structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

B&A—8 to 13 inches; reddish brown (5YR 4/4) clay loam (Bt); moderate medium subangular blocky structure; firm; common roots; thin patchy clay films on faces of peds in Bt portion; about 40 percent, by volume, tongues of dark brown (7.5YR 4/2) loam (A) more than 10 millimeters in diameter extend through this horizon; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

B21t—13 to 21 inches; reddish brown (5YR 4/4) clay; strong medium subangular blocky structure; firm; common roots; thin continuous clay films on faces of peds; estimated 3 percent gravel; mildly alkaline; clear wavy boundary.

B22t—21 to 26 inches; reddish brown (5YR 4/4) clay; weak medium prismatic structure parting to strong medium subangular blocky; firm; common roots; moderately thick continuous clay films on faces of peds; estimated 4 percent gravel; mildly alkaline; abrupt wavy boundary.

B3t—26 to 29 inches; reddish brown (5YR 4/4) gravelly clay loam; strong medium subangular blocky structure; firm; thick patchy clay films on faces of peds; estimated 19 percent gravel; mildly alkaline; abrupt wavy boundary.

R—29 inches; white (N 8/0) fractured dolomite; slight effervescence.

The solum is 20 to 40 inches thick. The depth to dolomite corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 3 and chroma of 2 or 3 and a 3- to 5-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. These horizons are dominantly loam, but some pedons have thin layers of silt loam. The B&A horizon has value and chroma of the A2 and Bt horizons. The B2t horizon is silty clay loam, silty clay, or clay. The B3t horizon is gravelly clay loam, silty clay, or silty clay loam. Coarse fragments in this horizon range from 0 to 20 percent. The R horizon is fractured dolomite in the upper several inches. The fractures are smaller and fewer in number with an increase in depth. Clay weathered from dolomite fills these fractures in some pedons.

Lamartine series

The Lamartine series consists of somewhat poorly drained, moderately permeable soils on concave slopes and in drainageways on till plains. These soils formed in silty deposits and in the underlying loamy glacial till. Slopes range from 0 to 3 percent.

Lamartine soils are adjacent on the landscape to Mayville and Pella soils. Mayville soils are moderately well drained; they are in slightly higher positions on the landscape surrounding Lamartine soils. Pella soils are poorly drained; they are in lower positions on the landscape.

Typical pedon of Lamartine silt loam, 0 to 3 percent slopes, 2,220 feet north and 35 feet east of SW corner of sec. 24, T. 17 N., R. 20 E. (in Calumet County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common roots; neutral; abrupt smooth boundary.

A2—8 to 10 inches; dark brown (10YR 4/3) silt loam; weak thin platy structure; friable; common roots; neutral; abrupt wavy boundary.

B1t—10 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; common roots; thin discontinuous clay films on faces of peds; many earthworm casts; mildly alkaline; clear wavy boundary.

B21t—14 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; few fine distinct grayish brown (10YR 5/2) and common medium prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; common roots; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

B22t—20 to 27 inches; dark yellowish brown (10YR 4/4) silt loam; few medium distinct grayish brown (10YR 5/2) and common medium prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few roots; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

IIB23t—27 to 32 inches; brown (10YR 5/3) clay loam; many medium faint grayish brown (10YR 5/2) and many fine prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few roots; thin discontinuous clay films on faces of peds; estimated 10 percent gravel; mildly alkaline; clear wavy boundary.

IIC—32 to 60 inches; pale brown (10YR 6/3) loam; many medium faint grayish brown (10YR 5/2) and many medium prominent yellowish brown (10YR 5/8) mottles; massive; friable; estimated 12 percent gravel and 3 percent cobblestones; slight effervescence; mildly alkaline.

The solum is 28 to 36 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2. Soils in uncultivated areas have a 6- or 7-inch A1 horizon that has value of 2 or 3 and chroma of 2. The A2 horizon is 2 to 4 inches thick and has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is silt loam or silty clay loam. The IIB3t horizon is clay loam or loam. Coarse fragments make up 5 to 10 percent of this horizon and 5 to 15 percent of the IIC horizon.

Lutzke series

The Lutzke series consists of well drained soils that are moderately permeable to moderately rapidly permeable in the surface layer and the subsoil and very rapidly permeable in the substratum. These soils are on outwash plains, terraces, eskers, and kames. They formed in gravelly outwash. Slopes range from 2 to 20 percent.

Lutzke soils are adjacent on the landscape to Boyer, Plainfield, and Wasepi soils. Boyer soils are well drained; they are in similar positions on the landscape but have less gravel in the B and C horizons than Lutzke soils. Plainfield soils are excessively drained; they are in similar positions on the landscape, do not have an argillic horizon, and have less gravel in their solum. Wasepi soils are somewhat poorly drained; they are in lower positions on the landscape in depressions and drainageways.

Typical pedon of Lutzke sandy loam, 2 to 6 percent slopes, 1,200 feet south and 660 feet west of NE corner of sec. 33, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) sandy loam; weak very fine subangular blocky structure; friable; common roots; estimated 8 percent gravel; mildly alkaline; abrupt smooth boundary.

B2t—6 to 19 inches; dark brown (7.5YR 4/4) gravelly clay loam; moderate fine subangular blocky structure; friable; common roots; moderately thick continuous clay films; estimated 30 percent gravel and 8 percent cobblestones; mildly alkaline; gradual wavy boundary.

B3t—19 to 24 inches; dark brown (7.5YR 4/4) gravelly loam; weak fine subangular blocky structure; friable; common roots; thin discontinuous clay films; estimated 43 percent gravel and 8 percent cobblestones; slight effervescence; mildly alkaline; clear wavy boundary.

C—24 to 60 inches; brown (7.5YR 5/4) very gravelly sand; single grained; loose; estimated 75 percent gravel and 12 percent cobblestones; strong effervescence; moderately alkaline.

The solum is 20 to 28 inches thick. The depth to free carbonates ranges from 16 to 24 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- to 4-inch A1 horizon that has value of 2 or 3 and chroma of 2 and a 2- or 3-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is dominantly gravelly clay loam and has thin layers of gravelly sandy loam or gravelly loam in some pedons. The B3t horizon is gravelly sandy loam, gravelly loam, or gravelly sandy clay loam. Coarse fragments make up 35 to 60 percent of the solum and 45 to 90 percent of the C horizon.

Manawa series

The Manawa series consists of somewhat poorly drained, slowly permeable soils in drainageways and depressions on till plains and in lacustrine basins. These soils formed in clayey glacial till or in clayey lacustrine deposits. Slopes range from 0 to 3 percent.

Manawa soils are adjacent on the landscape to Cosad, Kewaunee, Mosel, and Poygan soils. Cosad soils are somewhat poorly drained; they are in similar positions on the landscape but have 18 to 36 inches of sandy material in the upper part of the solum. Kewaunee soils are well drained; they are in higher positions on the landscape surrounding Manawa soils. Mosel soils are somewhat poorly drained; they are in similar positions on the landscape but have a loamy upper solum that is 20 to 36 inches thick. Poygan soils are poorly drained; they are in lower positions on the landscape.

Typical pedon of Manawa silt loam, 0 to 3 percent slopes, 2,600 feet east and 1,620 feet north of SW corner of sec. 27, T. 17 N., R. 23 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam; grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many roots; estimated 4 percent gravel; neutral; abrupt smooth boundary.

B1t—7 to 11 inches; brown (7.5YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct light yellowish brown (10YR 6/4) mottles; moderate fine and medium subangular blocky structure; friable; thin discontinuous clay films on vertical faces of peds; estimated 2 percent gravel; neutral; abrupt wavy boundary.

B2t—11 to 18 inches; reddish brown (5YR 5/4) clay; few fine distinct yellowish brown (10YR 5/6) and common medium prominent pinkish gray (5YR 7/2) mottles; moderate fine and medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

B3t—18 to 22 inches; reddish brown (5YR 5/4) clay; common medium distinct yellowish red (5YR 5/6) and many coarse prominent pinkish gray (5YR 7/2) mottles; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds;

estimated 5 percent gravel; mildly alkaline; clear wavy boundary.

C—22 to 60 inches; reddish brown (5YR 5/4) silty clay; many coarse distinct yellowish red (5YR 5/6) and many coarse prominent pinkish gray (5YR 7/2) mottles; weak medium platy structure; firm; free lime coatings on faces of peds; estimated 6 percent gravel; strong effervescence; mildly alkaline.

The solum is 20 to 34 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 1 to 3. Soils in uncultivated areas have a 5- or 6-inch A1 horizon that has value of 2 and chroma of 1 or 2 and a 1- to 3-inch A2 horizon that has value of 4 to 6 and chroma of 1 to 3. The Bt horizon is silty clay loam, silty clay, or clay. The C horizon is silty clay or clay. The content of coarse fragments is 3 to 10 percent in the lower part of the B horizon and 5 to 15 percent in the C horizon.

Mayville series

The Mayville series consists of moderately well drained, moderately permeable soils on broad flats between drumlins and on till plains. These soils formed in silty deposits and in the underlying glacial till. Slopes range from 1 to 3 percent.

These soils have a darker colored surface layer than that defined in the range of the series, but this difference does not affect use and management of these soils.

Mayville soils are adjacent on the landscape to Dodge and Lamartine soils. Dodge soils are well drained; they are in slightly higher convex positions on the landscape. Lamartine soils are somewhat poorly drained; they are in lower positions on the landscape in drainageways.

Typical profile of Mayville silt loam, 1 to 3 percent slopes, 30 feet south and 30 feet west of NE corner of sec. 7, T. 17 N., R. 20 E. (in Calumet County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few roots; mildly alkaline; abrupt smooth boundary.

B1—8 to 10 inches; dark yellowish brown (10YR 4/4) silt loam; weak thin platy structure; friable; few roots; neutral; clear wavy boundary.

B21t—10 to 14 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; few roots; thin continuous dark brown (10YR 3/3) clay films on faces of peds; mildly alkaline; clear wavy boundary.

B22t—14 to 28 inches; dark yellowish brown (10YR 4/4) silt loam; few medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

IIB23t—28 to 34 inches; yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam; weak coarse subangular blocky structure; friable; thin discontinuous clay films on faces of peds; estimated 3 percent gravel; mildly alkaline; clear wavy boundary.

IIC—34 to 60 inches; light yellowish brown (10YR 6/4) loam; few medium prominent strong brown (7.5YR 5/8) mottles; massive; friable; estimated 10 percent gravel; strong effervescence; mildly alkaline.

The solum is 30 to 40 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2. Soils in uncultivated areas have a 5- or 6-inch A1 horizon that has value of 2 and chroma of 1 or 2 and a 2- to 4-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is silt loam or silty clay loam. The IIB23t horizon is clay loam or silty clay loam and has an appreciable amount of sand. Coarse fragments in this horizon range from 1 to 10 percent. The IIC horizon is loam or gravelly loam. Coarse fragments in this horizon range from 5 to 20 percent.

Mosel series

The Mosel series consists of somewhat poorly drained, moderately slowly permeable soils along drainageways in glaciofluvial valleys. These soils formed in loamy and clayey lacustrine deposits or in glacial till. Slopes range from 0 to 3 percent.

Mosel soils are adjacent on the landscape to Kewaunee and Manawa soils. Kewaunee soils are well drained; they are in slightly higher positions on the landscape. Manawa soils are somewhat poorly drained; they are in similar positions on the landscape but have less sand than the upper solum of Mosel soils.

Typical pedon of Mosel loam, 0 to 3 percent slopes, 1,980 feet north and 20 feet west of SE corner of sec. 4, T. 20 N., R. 20 E. (in Calumet County):

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; weak medium granular structure; very friable; many roots; estimated 4 percent gravel; moderately alkaline; abrupt smooth boundary.

A2—9 to 12 inches; light brownish gray (10YR 6/2), pale brown (10YR 6/3), and strong brown (7.5YR 5/8) loam; weak fine subangular blocky structure; friable; common roots; estimated 8 percent gravel; neutral; clear wavy boundary.

B21t—12 to 17 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/8) loam; few fine distinct and prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very friable; common roots; thin continuous clay films on faces of peds; estimated 8 percent gravel; neutral; clear wavy boundary.

B22t—17 to 22 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/8) sandy loam; few fine distinct and prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very friable; common roots; thin continuous clay films on faces of peds; estimated 8 percent gravel; neutral; clear wavy boundary.

B23t—22 to 24 inches; reddish brown (5YR 4/4) loam; many coarse prominent strong brown (7.5YR 5/8) and common medium distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; friable; common roots; thin continuous clay films on faces of peds; estimated 8 percent gravel; neutral; clear wavy boundary.

IIB24t—24 to 29 inches; reddish brown (5YR 4/4) clay; few fine prominent gray (N 5/0) mottles; strong medium subangular blocky structure; firm; few roots; thin patchy clay films on faces of peds; estimated 8 percent gravel; mildly alkaline; clear wavy boundary.

IIB3—29 to 35 inches; reddish brown (5YR 4/4) silty clay loam; common medium distinct brown (7.5YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; estimated 8 percent gravel; mildly alkaline; clear wavy boundary.

IIC—35 to 60 inches; reddish brown (5YR 4/4) silty clay loam; common fine prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure grading to massive with increasing depth; firm; few roots; estimated 8 percent gravel; strong effervescence; mildly alkaline.

The solum is 30 to 40 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 1 to 3. Soils in uncultivated areas have a 5- or 6-inch A1 horizon that has value of 2 or 3 and chroma of 1 to 3. The A2 horizon is 2 or 3 inches thick and has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is sandy loam, loam, or sandy clay loam. The IIB24t horizon is silty clay loam, silty clay, or clay. The IIC horizon is silty clay loam, silty clay, or clay. Coarse fragments in the IIB and IIC horizons range from 1 to 10 percent.

Mundelein series

The Mundelein series consists of somewhat poorly drained, moderately permeable or moderately slowly permeable soils in glacial lake basins and depressions. These soils formed in silty deposits underlain by stratified, calcareous silt and very fine sand. Slopes range from 0 to 3 percent.

Mundelein soils are adjacent on the landscape to Pella and Zurich soils. Pella soils are poorly drained; they are in lower positions on the landscape in depressions. Zurich soils are well drained; they are in higher positions on the landscape and have convex slopes.

Typical pedon of Mundelein silt loam, 0 to 3 percent slopes, 2,610 feet south and 1,600 feet east of NW corner of sec. 3l, T. 19 N., R. 24 E. (in Manitowoc County):

Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B1t—9 to 14 inches; brown (7.5YR 4/4) silty clay loam; many fine prominent strong brown (7.5YR 5/8) mottles; weak medium and fine subangular blocky structure; friable; few roots; thin patchy clay films on faces of peds; neutral; clear wavy boundary.

B2t—14 to 23 inches; brown (7.5YR 5/4) silty clay loam; many fine prominent strong brown (7.5YR 5/8) and common fine prominent gray (N 6/0) mottles; moderate medium subangular blocky structure; friable; few roots; thin patchy clay films on faces of peds; neutral; clear wavy boundary.

B3—23 to 26 inches; brown (7.5YR 5/4) silt loam; many coarse prominent strong brown (7.5YR 5/8) and many medium prominent gray (N 6/0) mottles; weak thick platy structure parting to weak fine subangular blocky; friable; mildly alkaline; clear wavy boundary.

C—26 to 60 inches; pinkish gray (7.5YR 6/2) and brown (7.5YR 5/4) stratified silt and very fine sand; massive; friable; strong effervescence; mildly alkaline.

The solum is 24 to 30 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2. Soils in uncultivated areas have a 7- or 8-inch A1 horizon that has value of 2 and chroma of 1 or 2 and a 2- or 3-inch A3 horizon that has value of 3 and chroma of 1 or 2. The B3 horizon is silt loam or very fine sandy loam. The C horizon has thin bands of loam and very fine sandy loam in some pedons.

Nichols series

The Nichols series consists of well drained and moderately well drained, moderately permeable soils on lacustrine plains. These soils formed in water-laid loamy material. Slopes range from 2 to 25 percent.

These soils have a slightly warmer soil temperature than that defined in the range of the series, but this difference does not affect use and management of these soils.

Nichols soils are adjacent on the landscape to Boyer and Shiocton soils. Boyer soils are well drained; they are in similar positions on the landscape but have a sand and gravel C horizon. Shiocton soils are somewhat poorly drained; they are in lower positions on the landscape on concave side slopes and in drainageways.

Typical pedon of Nichols very fine sandy loam, 2 to 6 percent slopes, 1,350 feet south and 60 feet east of NW corner of sec. 2, T. 17 N., R. 23 E. (in Manitowoc County):

Ap—0 to 8 inches; dark brown (10YR 3/3) very fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; common roots; mildly alkaline; abrupt smooth boundary.

B21—8 to 18 inches; pale brown (10YR 6/3) very fine sandy loam; weak medium platy structure parting to weak very fine subangular blocky; very friable; common roots; mildly alkaline; abrupt wavy boundary.

B22—18 to 23 inches; light brown (7.5YR 6/4) very fine sandy loam; many fine distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; few roots; slight effervescence in the lower part; mildly alkaline; clear wavy boundary.

C—23 to 60 inches; very pale brown (10YR 7/3) very fine sand that has thin silt bands; few fine prominent strong brown (7.5YR 5/8) mottles; weak medium platy structure; friable; violent effervescence; mildly alkaline.

The solum is 16 to 30 inches thick. The depth to free carbonates is commonly the same as the thickness of the solum, but in some pedons the lower several inches of the subsoil has free carbonates.

The Ap horizon has value of 3 or 4 and chroma of 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 2 or 3 and chroma of 2 and a 2- to 4-inch A2 horizon that has value of 5 and chroma of 2 or 3. These horizons are very fine sandy loam and have thin or transitional layers of fine sandy loam, loam, or silt loam. The B2 horizon has value of 4 to 6 and chroma of 3 or 4. It is very fine sandy loam, fine sandy loam, or silt loam and less commonly loam. The C horizon is very fine sand and has thin or transitional layers of silt, silt loam, and fine sandy loam.

Oakville series

The Oakville series consists of well drained, rapidly permeable soils on side slopes of beach ridges, lake plains, and moraines. These soils formed in fine sand deposits. Slopes range from 0 to 12 percent.

Oakville soils are adjacent on the landscape to Boyer, Nichols, Tedrow, and Tustin soils. Boyer soils are well drained; they are in positions on the landscape similar to those of the Oakville soils, but they have a finer textured B horizon and a sand and gravel C horizon. Nichols soils are well drained and moderately well drained; they are in similar positions on the landscape but formed in finer materials. Tedrow soils are somewhat poorly drained; they are in lower positions on the landscape in drainageways. Tustin soils are well drained; they are in similar positions on the landscape but are clayey in the lower part of the B horizon and in the C horizon.

Typical profile of Oakville loamy fine sand, 2 to 6 percent slopes, 850 feet east and 700 feet south of NW corner of sec. 29, T. 20 N., R. 25 E. (in Manitowoc County):

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 4/3) dry; weak medium subangular blocky structure; very friable; many roots; slightly acid; abrupt wavy boundary.

B2—9 to 16 inches; strong brown (7.5YR 5/6) fine sand; weak medium subangular blocky structure; very friable; common roots; slightly acid; gradual wavy boundary.

B3—16 to 38 inches; yellowish brown (10YR 5/6) fine sand; single grained; loose; slightly acid; clear wavy boundary.

C—38 to 60 inches; white (10YR 8/2) fine sand; single grained; loose; slight effervescence; mildly alkaline.

The solum is 20 to 40 inches thick. The depth to free carbonates ranges from 24 to 40 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- to 5-inch A1 horizon that has value of 2 and chroma of 1 or 2. The A2 horizon is as much as 4 inches thick and has value of 4 or 5 and chroma of 2 or 3. The B2 horizon has hue of 7.5YR or 10YR. The C horizon is dominantly fine sand, but some pedons have thin lamellae of loamy fine sand below a depth of 40 inches.

Omro series

The Omro series consists of well drained soils on crests and side slopes of rises on till plains. These soils are slowly permeable in the subsoil and moderately permeable in the substratum. They formed in loamy and clayey deposits over calcareous loamy glacial till. Slopes range from 4 to 12 percent.

Omro soils are adjacent on the landscape to Hochheim, Hortonville, and Kewaunee soils. Hochheim soils are well drained; they are in similar positions on the landscape but have a coarser textured argillic horizon. Hortonville soils are well drained; they are in similar positions on the landscape but have a coarser textured argillic horizon. Kewaunee soils are well drained; they are in similar positions on the landscape but have a finer textured C horizon.

Typical pedon of Omro loam, 4 to 12 percent slopes, eroded, 1,060 feet north and 200 feet east of SW corner of sec. 20, T. 20 N., R. 22 E. (in Manitowoc County):

Ap—0 to 7 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; moderate medium granular structure; friable; common roots; mildly alkaline; abrupt smooth boundary.

B1—7 to 9 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; friable; common roots; mildly alkaline; clear wavy boundary.

B21t—9 to 16 inches; reddish brown (5YR 4/4) clay; strong fine angular blocky structure; firm; few roots; moderately thick continuous clay films on faces of peds; estimated 5 percent gravel; mildly alkaline; clear wavy boundary.

B22t—16 to 22 inches; reddish brown (5YR 4/4) clay; weak coarse prismatic structure parting to strong fine angular blocky; firm; few roots; moderately thick continuous clay films on faces of peds; estimated 5 percent gravel; mildly alkaline; clear wavy boundary.

B3t—22 to 29 inches; reddish brown (5YR 4/4) clay; moderate fine subangular blocky structure; firm; few roots; thin patchy clay films on faces of peds; estimated 4 percent gravel; mildly alkaline; abrupt smooth boundary.

IIC—29 to 60 inches; brown (10YR 5/3) loam; common medium prominent brownish yellow (10YR 6/8) mottles; weak thin platy structure; friable; estimated 10 percent gravel; slight effervescence; mildly alkaline.

The solum is 24 to 38 inches thick. The depth to free carbonates commonly corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 3 and chroma of 1 or 2 and a 3- to 5-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. The Bt horizon is commonly clay but has thin subhorizons of silty clay, clay loam, or silty clay loam. The IIC horizon is sandy loam, fine sandy loam, or loam. Coarse fragments in this horizon range from 10 to 18 percent.

Palms series

The Palms series consists of very poorly drained soils in depressions in glacial lake basins. These soils are moderately rapidly permeable in the organic layers and moderately slowly permeable in the substratum. They formed in 16 to 50 inches of muck over lacustrine silt and very fine sand. Slopes range from 0 to 2 percent.

Palms soils are similar to Adrian and Houghton soils and are commonly adjacent to Keowns and Pella soils on the landscape. Adrian soils are very poorly drained organic soils that are underlain by sand. Houghton soils are very poorly drained and have more than 51 inches of muck. Keowns and Pella soils are poorly drained; they are in slightly higher positions on the landscape surrounding Palms soils. Keowns and Pella soils formed in mineral soil material.

Typical pedon of Palms muck, 2,000 feet west and 40 feet south of NE corner of sec. 3l, T. 2l N., R. 24 E. (in Manitowoc County):

Oal—0 to 13 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 15 percent fiber, less than 5 percent rubbed; weak fine granular structure; nonsticky; common roots; mildly alkaline; clear wavy boundary.

Oa2—13 to 27 inches; very dark grayish brown (10YR 3/2) broken face sapric material, very dark gray (10YR 3/1) rubbed and pressed; about 12 percent fiber, less than 5 percent rubbed; weak medium granular structure; nonsticky; few roots; neutral; clear wavy boundary.

Oa4—27 to 36 inches; very dark brown (10YR 2/2) broken face sapric material, black (10YR 2/1) rubbed and very dark gray (10YR 3/1) pressed; about 10 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; nonsticky; neutral; abrupt wavy boundary.

IIC—36 to 60 inches; gray (10YR 6/1) stratified silt and very fine sand; massive; friable; slight effervescence; mildly alkaline.

The organic horizons are 16 to 50 inches thick. They have value of 2 or 3 and chroma of 1 or 2. Thin layers of hemic material are in some pedons. The IIC horizon has value of 4 to 6 and chroma of 1 or 2.

Pella series

The Pella series consists of poorly drained, moderately permeable soils in depressions on till plains. These soils formed in silty deposits. Slopes range from 0 to 2 percent.

Pella soils are adjacent on the landscape to Lamartine and Palms soils. Lamartine soils are somewhat poorly drained and are underlain by loamy glacial till; they are in slightly higher positions on the landscape. Palms soils are very poorly drained organic soils; they are in lower positions on the landscape.

Typical pedon of Pella silt loam, 2,660 feet west and 75 feet south of NE corner of sec. 16, T. 17 N., R. 20 E. (in Calumet County):

Ap—0 to 10 inches; black (10YR 2/1) silt loam, grayish brown (10YR 5/2) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; many roots; mildly alkaline; abrupt smooth boundary.

B1g—10 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent yellowish brown (10YR 5/8) mottles; weak thick platy structure parting to weak fine subangular blocky; friable; mildly alkaline; clear wavy boundary.

B2g—22 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; friable; mildly alkaline; clear wavy boundary.

C1—30 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/8) mottles; massive; friable; few black (N 2/0) manganese concretions; common light gray (10YR 7/1) secondary lime concretions; slight effervescence; mildly alkaline; clear wavy boundary.

IIC2—36 to 60 inches; grayish brown (2.5Y 5/2) silt loam; many coarse prominent yellowish brown (10YR 5/8) mottles; massive; friable; estimated 3 percent gravel; few black (N 2/0) manganese concretions; common light gray (10YR 7/1) secondary lime concretions; greater percentage of coarse sand than in the C1 horizon; slight effervescence; mildly alkaline.

The solum is 25 to 37 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A horizon is 9 to 11 inches thick and has value of 2 or 3 and chroma of 1. The Bg horizon has value of 4 to 6 and chroma of 1 or 2. The IIC horizon is silt loam, loam, or sandy loam.

Plainfield series

The Plainfield series consists of excessively drained, rapidly permeable soils on stream terraces, escarpments, and sides of moraines. These soils formed in sandy drift. Slopes range from 2 to 20 percent.

Plainfield soils are adjacent on the landscape to Boyer, Lutzke, Tedrow, and Tustin soils. Boyer soils are well drained; they are in similar positions on the landscape but have less sand and more clay in the solum. Lutzke soils are well drained; they are in similar positions on the landscape but have less sand and more clay in the solum and more coarse fragmemts in the solum and C horizon. Tedrow soils are somewhat poorly drained; they are in lower positions on the landscape in drainageways. Tustin soils are well drained; they are in similar positions on the landscape as Plainfield soils but have clay in the lower part of the B horizon and C horizon.

Typical pedon of Plainfield loamy sand, 2 to 6 percent slopes, 540 feet south and 1,300 feet west of NE corner of sec. 27, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 10 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; common roots; slightly acid; abrupt smooth boundary.

A3—10 to 13 inches; dark brown (10YR 4/3) loamy sand; weak coarse subangular blocky structure; very friable; common roots; medium acid; clear wavy boundary.

B2—13 to 19 inches; strong brown (7.5YR 5/6) sand; weak coarse subangular blocky structure; very friable; medium acid; clear wavy boundary.

B3—19 to 26 inches; yellowish brown (10YR 5/6) sand; single grained; loose; medium acid; clear wavy boundary.

C1—26 to 48 inches; strong brown (7.5YR 5/6) sand; single grained; loose; medium acid; clear wavy boundary.

C2—48 to 60 inches; light yellowish brown (10YR 6/4) sand; single grained; loose; estimated 6 percent fine gravel; neutral.

The solum is 20 to 34 inches thick. The depth to free carbonates is more than 60 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- or 4-inch A1 horizon that has value of 2 or 3 and chroma of 2 and a 5- or 6-inch A2 horizon that has value of 4 to 6 and chroma of 2 or 3. The B horizon has value and chroma of 4 to 6. Coarse fragments in the C horizon range from 0 to 10 percent.

Poygan series

The Poygan series consists of poorly drained, slowly permeable soils in depressions and drainageways in till plains and in lacustrine basins. These soils formed in clayey till or lacustrine deposits. Slopes range from 0 to 2 percent.

Poygan soils are adjacent on the landscape to Manawa and Willette soils. Manawa soils are somewhat poorly drained; they are in slightly higher positions on the landscape surrounding Poygan soils. Willette soils are very poorly drained organic soils; they are in lower positions on the landscape.

Typical pedon of Poygan silty clay loam, 100 feet west and 960 feet south of NE corner of sec. 33, T. 20 N., R. 20 E. (in Calumet County):

Ap—0 to 10 inches; black (N 2/0) silty clay loam; weak medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

B2g—10 to 15 inches; grayish brown (2.5Y 5/2) silty clay; many fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; neutral; abrupt wavy boundary.

B3—15 to 19 inches; reddish brown (5YR 4/4) clay; many medium distinct yellowish red (5YR 4/6) and few fine distinct grayish brown (10YR 5/2) mottles; strong fine subangular blocky structure; firm; estimated 4 percent gravel; mildly alkaline; clear wavy boundary.

C—19 to 60 inches; reddish brown (5YR 4/4) clay; common fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; estimated 4 percent gravel; common light gray (10YR 7/2) secondary lime concretions; strong effervescence; mildly alkaline.

The solum is 15 to 24 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A horizon is 9 to 11 inches thick and has value of 2 and chroma of 0 or 1. The B horizon is silty clay or clay and less commonly silty clay loam. Coarse fragments in the solum and C horizon range from 0 to 10 percent.

Shiocton series

The Shiocton series consists of somewhat poorly drained, moderately permeable soils in drainageways in glacial lake basins. These soils formed in loamy, water-laid deposits. Slopes range from 0 to 3 percent.

These soils have a slightly warmer soil temperature than that defined in the range of the series, but this difference does not affect use and management of these soils.

Shiocton soils are adjacent on the landscape to Mundelein, Nichols, and Pella soils. Mundelein soils are somewhat poorly drained; they are in similar positions on the landscape but have a finer textured B horizon. Nichols soils are well drained and moderately well drained; they are in higher positions on the landscape and have convex slopes. Pella soils are poorly drained silty soils; they are in lower positions on the landscape in depressions.

Typical pedon of Shiocton very fine sandy loam, 0 to 3 percent slopes, 1,710 feet north and 850 feet east of SW corner of sec. 2, T. 20 N., R. 20 E. (in Calumet County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; weak medium granular structure; very friable; many roots; neutral; abrupt smooth boundary.

A2—8 to 9 inches; dark grayish brown (10YR 4/2) very fine sandy loam; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; many roots; neutral; abrupt smooth boundary.

B21—9 to 14 inches; yellowish brown (10YR 5/6) and light reddish brown (5YR 6/4) very fine sandy loam; common coarse prominent light brownish gray (10YR 6/2) mottles; weak medium platy structure parting to weak very fine subangular blocky; very friable; common roots; neutral; clear wavy boundary.

B22—14 to 21 inches; yellowish brown (10YR 5/6) and light reddish brown (5YR 6/4) very fine sandy loam; common coarse prominent light brownish gray (10YR 6/2) mottles; weak medium platy structure parting to weak very fine subangular blocky; very friable; common roots; mildly alkaline; clear wavy boundary.

C1—21 to 26 inches; light reddish brown (5YR 6/4) very fine sand; many coarse distinct yellowish brown (10YR 5/6) and common coarse prominent light brownish gray (10YR 6/2) mottles; weak medium platy structure; very friable; few roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—26 to 32 inches; reddish brown (5YR 5/4) very fine sand; common coarse distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; weak thin platy structure; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C3—32 to 60 inches; yellowish brown (10YR 5/6), brownish yellow (10YR 6/6), pinkish gray (7.5YR 6/2), and reddish brown (5YR 5/4) silt; laminated in bands from 1 millimeter to 5 millimeters thick; massive; very friable; strong effervescence; mildly alkaline.

The solum is 18 to 24 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A1 or Ap horizon is 8 to 10 inches thick and has value of 2 or 3 and chroma of 1 or 2. Some pedons have an A2 horizon that is as much as 2 inches thick. The B horizon has value of 4 to 6 and chroma of 3 to 6. It is very fine sandy loam or loamy very fine sand or less commonly silt loam.

Symco series

The Symco series consists of somewhat poorly drained, moderately slowly permeable soils in drainageways on till plains and ground moraines. These soils formed in loamy glacial till. Slopes range from 0 to 3 percent.

Symco soils are adjacent on the landscape to Brookston, Hortonville, and Manawa soils. Brookston soils are very poorly drained; they are in slightly lower positions on the landscape. Hortonville soils are well drained; they are in higher positions on the landscape. Manawa soils are somewhat poorly drained; they are in positions on the landscape similar to those of Symco soils, but they have finer textured B and C horizons.

Typical pedon of Symco silt loam, 0 to 3 percent slopes, 60 feet north and 2,510 feet east of SW corner of sec. 3, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; many roots; mildly alkaline; abrupt smooth boundary.

B1—8 to 15 inches; dark brown (7.5YR 4/4) loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; estimated 5 percent gravel; mildly alkaline; clear wavy boundary.

B2t—15 to 23 inches; brown (7.5YR 5/4) clay loam; many medium prominent strong brown (7.5YR 5/8) and common medium distinct pinkish gray (7.5YR 6/2) mottles; moderate medium subangular blocky structure; friable; thin discontinuous clay films on faces of peds; estimated 8 percent gravel; mildly alkaline; clear wavy boundary.

B3—23 to 28 inches; reddish brown (5YR 5/4) loam; common medium prominent yellowish red (5YR 5/8) and common coarse distinct pinkish gray (5YR 6/2) mottles; moderate medium and fine subangular blocky structure; friable; estimated 8 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C—28 to 60 inches; reddish brown (5YR 5/4) loam; common medium prominent yellowish red (5YR 5/8) and common coarse distinct pinkish gray (5YR 6/2) mottles; massive; friable; estimated 8 percent gravel; violent effervescence; moderately alkaline.

The solum is 20 to 32 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 2 or 3 and chroma of 2. Soils in uncultivated areas have a 4- to 6-inch A1 horizon that has value of 2 or 3 and chroma of 1 or 2 and a 2- or 3-inch A2 horizon that has value of 4 or 5 and chroma of 2 or 3. The B2t horizon is silt loam, clay loam, or silty clay loam. The C horizon is loam, clay loam, or silty clay loam. Coarse fragments in the solum and C horizon range from 3 to 10 percent.

Tedrow series

The Tedrow series consists of somewhat poorly drained, rapidly permeable soils in drainageways on lake plains and on old beaches. These soils formed in deposits of fine sand. Slopes range from 0 to 3 percent.

Tedrow soils are adjacent on the landscape to Granby and Oakville soils. Granby soils are poorly drained; they are in slightly lower positions on the landscape. Oakville soils are well drained; they are in higher positions on the landscape.

Ap—0 to 7 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak coarse subangular blocky structure; very friable; many roots; slightly acid; abrupt smooth boundary.

B2—7 to 12 inches; strong brown (7.5YR 5/6) fine sand; weak coarse subangular blocky structure; very friable; common roots; slightly acid; gradual wavy boundary.

B3—12 to 25 inches; yellowish brown (10YR 5/4) fine sand; common coarse distinct light brownish gray (10YR 6/2), common medium prominent yellowish red (5YR 5/8), and few medium prominent strong brown (7.5YR 5/8) mottles; single grained; loose; few roots; slightly acid; gradual wavy boundary.

C—25 to 60 inches; yellowish brown (10YR 5/4) fine sand; few fine prominent strong brown (7.5YR 5/8) mottles; single grained; loose; mildly alkaline.

The solum is 24 to 30 inches thick. The depth to free carbonates is more than 60 inches.

The Ap horizon has value of 3 and chroma of 2 or 3. Soils in uncultivated areas have an A1 horizon that has value of 2 or 3 and chroma of 1 or 2. In some pedons there is an A2 horizon, which is 1 to 3 inches thick and has value of 4 or 5 and chroma of 2 or 3. The B horizon has value of 4 to 6 and chroma of 3 to 6. It is dominantly fine sand and has thin layers of loamy fine sand or loamy sand in some pedons. The C horizon has value of 4 to 6 and chroma of 3 or 4. It is sand or fine sand.

Theresa series

The Theresa series consists of well drained, moderately permeable soils on till plains. These soils formed in a thin silty mantle and in the underlying loamy glacial till. Slopes range from 2 to 6 percent.

Theresa soils are adjacent to Hochheim, Lamartine, and Mayville soils. Hochheim soils are well drained; they are in similar positions on the landscape but have a thinner solum. Lamartine soils are somewhat poorly drained; they are in lower positions on the landscape. Mayville soils are moderately well drained; they are between Theresa and Lamartine soils on the landscape.

Typical pedon of Theresa silt loam, 2 to 6 percent slopes, 1,000 feet west and 100 feet south of NE corner of sec. 12, T. 17 N., R. 20 E. (in Calumet County):

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; many fine fibrous roots; mildly alkaline; abrupt smooth boundary.

A2—8 to 10 inches; brown (10YR 5/3) silt loam; moderate medium platy structure; friable; common fine fibrous roots; mildly alkaline; clear wavy boundary.

B1—10 to 14 inches; brown (10YR 4/3) silt loam; moderate medium and fine subangular blocky structure; firm; common fine fibrous roots; slightly acid; clear wavy boundary.

B21t—14 to 18 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium and fine subangular blocky structure; firm; few fine fibrous roots; common thin clay films on faces of peds; thin patchy brown (10YR 5/3) silt coatings on some vertical faces of peds; slightly acid; clear wavy boundary.

IIB22t—18 to 24 inches; dark brown (7.5YR 4/4) clay loam; moderate medium angular blocky and subangular blocky structure; firm; few fine fibrous roots; thick continuous brown (7.5YR 4/2) clay films on faces of peds and in pores; neutral; clear wavy boundary.

IIB3t—24 to 34 inches; dark brown (7.5YR 4/4) and brown (7.5YR 5/4) loam; weak and moderate medium subangular blocky structure; firm; few thin discontinuous clay films on faces of peds; some partially weathered dolomite pebbles; slight effervescence; moderately alkaline; clear wavy boundary.

IIC—34 to 60 inches; yellowish brown (10YR 5/4) loam; weak very thick platy structure parting to weak medium subangular blocky; friable; estimated 10 percent gravel and some cobblestones, mostly weathered dolomite pebbles with some of mixed lithology; strong effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. The depth to free carbonates ranges from 20 to 30 inches; the lower part of the B3 horizon has free carbonates. The silty mantle is 10 to 22 inches thick.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 4- or 5-inch A1 horizon that has value of 2 or 3 and chroma of 1 or 2. The A2 horizon has value of 4 or 5 and chroma of 2 or 3. The B21t horizon is dominantly silty clay loam and has thin or transitional horizons of silt loam. The IIB22t horizon is clay loam or loam. Coarse fragments in this horizon range from 0 to 10 percent. The IIC horizon is dominantly loam and less commonly sandy loam. Coarse fragments in the IIC horizon range from 5 to 20 percent.

Tustin series

The Tustin series consists of well drained soils on terraces along rivers and around glacial lake basins. These soils are moderately rapidly permeable in the upper part of the solum and slowly permeable in the lower part of the solum and in the substratum. They formed in sandy outwash and in the underlying clayey till or lacustrine deposits. Slopes range from 2 to 6 percent.

Tustin soils are adjacent on the landscape to Oakville, Plainfield, and Nichols soils. Oakville, Plainfield, and Nichols soils are in similar positions on the landscape but do not have the clayey lower part of the B horizon and the C horizon of Tustin soils.

Typical pedon of Tustin loamy fine sand, 2 to 6 percent slopes, 1,720 feet north and 1,250 feet east of SW corner of sec. 32, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common roots; neutral; abrupt smooth boundary.

B1—8 to 14 inches; yellowish brown (10YR 5/6) loamy fine sand; weak coarse subangular blocky structure; very friable; common roots; neutral; clear wavy boundary.

B21—14 to 20 inches; brown (7.5YR 4/4) loamy fine sand; weak coarse subangular blocky structure; very friable; few roots; neutral; clear wavy boundary.

B22—20 to 26 inches; yellowish brown (10YR 5/4) loamy fine sand; few fine prominent yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; very friable; few roots; neutral; abrupt wavy boundary.

IIB23t—26 to 32 inches; reddish brown (5YR 5/4) silty clay; moderate very fine subangular blocky structure; firm; few roots; thin continuous clay films on faces of peds; neutral; clear wavy boundary.

IIB3t—32 to 39 inches; reddish brown (5YR 5/4) silty clay; moderate medium subangular blocky structure; firm; few roots; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

IIC—39 to 60 inches; reddish brown (5YR 5/4) silty clay; massive; firm; strong effervescence; mildly alkaline.

The solum is 30 to 50 inches thick. The sandy upper part of the solum is 20 to 32 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 3. Soils in uncultivated areas have a 3- to 5-inch A1 horizon that has value and chroma of 2 or 3 and a 2- to 4-inch A2 horizon that has value of 4 to 6 and chroma of 2 or 3. The B horizon is loamy sand or loamy fine sand. The IIB2t and IIB3t horizons are silty clay loam, silty clay, or clay. The IIC horizon is silty clay loam, silty clay, or clay.

Wasepi series

The Wasepi series consists of somewhat poorly drained soils in drainageways and in depressions in outwash plains and stream terraces. These soils are moderately rapidly permeable in the subsoil and very rapidly permeable in the substratum. They formed in loamy material and in the underlying sand and gravel. Slopes range from 0 to 3 percent.

These soils contain a slightly smaller amount of clay than that defined in the range for the series. This difference does not affect the use and management of these soils.

Wasepi soils are adjacent on the landscape to Boyer and Granby soils. Boyer soils are well drained; they are in higher convex positions on the landscape. Granby soils are sandy throughout and are poorly drained; they are in lower positions on the landscape in depressions.

Typical pedon of Wasepi sandy loam, 0 to 3 percent slopes, 1,730 feet south and 25 feet east of NW corner of sec. 6, T. 18 N., R. 24 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark brown (10YR 2/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; many roots;

estimated 8 percent gravel; neutral; abrupt smooth boundary.

A2—7 to 11 inches; brown (10YR 5/3) sandy loam; few medium prominent yellowish red (5YR 5/6) mottles; weak medium subangular blocky structure; very friable; common roots; many earthworm casts; estimated 5 percent gravel; slightly acid; clear wavy boundary.

B2t—11 to 18 inches; yellowish brown (10YR 5/6) sandy loam; common medium distinct brownish yellow (10YR 6/8), few fine distinct pale yellow (5Y 7/4), and few fine prominent grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very friable; common roots; thin discontinuous clay films on larger faces of peds; common very dark brown (10YR 2/2) earthworm casts; estimated 10 percent gravel; medium acid; clear wavy boundary.

B3—18 to 23 inches; brownish yellow (10YR 6/6) gravelly loamy sand; many coarse faint yellowish brown (10YR 5/6), few medium distinct reddish brown (5YR 5/4), and common medium prominent light gray (10YR 7/2) mottles; weak coarse subangular blocky structure; very friable; few roots; estimated 25 percent gravel; neutral; clear wavy boundary.

C—23 to 60 inches; light brownish gray (10YR 6/2) sand and gravel; few fine prominent yellowish brown (10YR 5/6) mottles; single grained; loose; estimated 25 percent gravel; strong effervescence; neutral.

The solum is 20 to 36 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A1 or Ap horizon is 5 to 8 inches thick and has value of 2 or 3 and chroma of 1 or 2. The A2 horizon is 4 to 6 inches thick and has value of 5 or 6 and chroma of 2 or 3. The B2t horizon is dominantly sandy loam, but thin or transitional layers of loamy sand and sandy clay loam are in some pedons. Coarse fragments in the solum range from 5 to 30 percent; the highest percentage is in the B3 horizon. Coarse fragments in the C horizon range from 10 to 30 percent.

Wauseon series

The Wauseon series consists of very poorly drained soils in depressions on till plains and in lacustrine basins. These soils are rapidly permeable in the solum and very slowly permeable in the substratum. They formed in loamy and sandy deposits over clayey till or lacustrine deposits. Slopes range from 0 to 2 percent.

Wauseon soils are adjacent on the landscape to Manawa, Mosel, and Willette soils. Manawa and Mosel soils are somewhat poorly drained; they are in higher positions on the landscape. Willette soils are very poorly drained organic soils; they are in slightly lower positions on the landscape.

Typical pedon of Wauseon sandy loam, 1,060 feet south and 2,600 feet west of NE corner of sec. 7, T. 20 N., R. 23 E. (in Manitowoc County):

Ap—0 to 10 inches; black (10YR 2/1) sandy loam; few medium prominent yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure parting to weak medium granular; friable; many roots; neutral; abrupt smooth boundary.

B1g—10 to 11 inches; grayish brown (10YR 5/2) sandy loam; many fine prominent yellowish brown (10YR 5/8) mottles; weak medium and fine subangular blocky structure; friable; few roots; neutral; abrupt wavy boundary.

B21g—11 to 17 inches; light brownish gray (10YR 6/2) loamy sand; common fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very friable; few roots; neutral; clear wavy boundary.

B22g—17 to 22 inches; grayish brown (10YR 5/2) sandy loam; many coarse distinct yellowish brown (10YR 5/4) and many coarse prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; friable; few roots; neutral; clear wavy boundary.

B23g—22 to 26 inches; dark grayish brown (10YR 4/2) sandy loam; many coarse prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; friable; few roots; neutral; abrupt wavy boundary.

IIC—26 to 60 inches; reddish brown (5YR 5/4) silty clay; many fine prominent gray (5YR 6/1) lime segregations; massive; firm; slight effervescence; mildly alkaline.

The solum is 24 to 36 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The A horizon is 10 to 12 inches thick and has value of 2 and chroma of 1 or 2. The IIC horizon is silty clay, clay, or silty clay loam.

Waymor series

The Waymor series consists of well drained, moderately permeable soils on till plains and moraines. These soils formed in loess and loamy glacial till. Slopes range from 2 to 20 percent.

Waymor soils are adjacent on the landscape to Boyer, Hortonville, and Symco soils. Boyer soils are well drained; they are in similar positions on the landscape but have a sand and gravel C horizon. Hortonville soils are well drained; they are in similar positions on the landscape but have more clay in the B and C horizons. Symco soils are somewhat poorly drained; they are in lower positions on the landscape.

Typical pedon of Waymor silt loam, 2 to 6 percent slopes, 140 feet east and 820 feet north of SW corner of sec. 10, T. 21 N., R. 22 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; many roots; neutral; abrupt smooth boundary.

A2—7 to 10 inches; brown (10YR 5/3) silt loam; weak medium platy structure; friable; many roots; neutral; clear wavy boundary.

A&B—10 to 13 inches; about 60 percent, by volume, brown (10YR 5/3) tongues of silt loam (A2) 15 to 25 millimeters wide with weak medium platy structure surrounding remnants of reddish brown (5YR 4/4) loam (Bt); friable; many roots; neutral; clear irregular boundary.

IIB&A—13 to 16 inches; reddish brown (5YR 4/4) loam (Bt); weak fine subangular blocky structure; grayish brown (10YR 5/2) loam (A2) that tongues into and surrounds some peds of Bt; weak medium platy structure; friable; many roots; neutral; clear irregular boundary.

IIB21t—16 to 24 inches; reddish brown (5YR 4/4) loam; moderate fine angular blocky structure; firm; thick continuous dark reddish brown (5YR 3/4) clay films on faces of peds; many roots; estimated 5 percent gravel and 10 percent cobblestones; neutral; gradual wavy boundary.

IIB22t—24 to 35 inches; reddish brown (5YR 4/4) loam; weak fine angular blocky structure; firm; thick continuous reddish brown (5YR 4/3) clay films on faces of peds; many roots; estimated 3 percent gravel and 10 percent cobblestones; mildly alkaline; gradual wavy boundary.

IIC—35 to 60 inches; dark brown (7.5YR 4/4) loam and sandy loam; weak medium angular blocky structure; friable; estimated 3 percent gravel and 8 percent cobblestones; slight effervescence; moderately alkaline.

The solum is 28 to 40 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap or A1 horizon has value of 2 or 3 and chroma of 1 to 3. The A2 horizon is 3 to 6 inches thick and has value of 4 to 6 and chroma of 2 to 4. The IIB21t horizon is dominantly loam and has thin or transitional horizons of clay loam or silty clay loam. The IIB22t horizon is loam or clay loam.

Whalan series

The Whalan series consists of moderately deep, well drained, moderately slowly permeable soils on glaciated bedrock-controlled uplands. Slopes range from 2 to 6 percent.

Whalan soils are adjacent on the landscape to Channahon and Theresa soils. Channahon soils are well drained; they are in similar positions on the landscape but have a thinner solum over dolomite. Theresa soils are well drained; they are in similar positions on the landscape but are underlain by glacial till.

Typical pedon of Whalan silt loam, 2 to 6 percent slopes, 50 feet south and 1,060 feet east of NW corner of government lot 193, T. 17 N., R. 19 E. (in Calumet County):

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common roots; slightly acid; abrupt smooth boundary.

A2—8 to 12 inches; brown (10YR 5/3) silt loam; weak medium platy structure parting to weak very fine granular; very friable; common roots; strongly acid; clear wavy boundary.

B1—12 to 17 inches; dark brown (7.5YR 4/4) silt loam; weak medium subangular blocky structure; friable; common roots; neutral; clear wavy boundary.

B21t—17 to 25 inches; dark brown (7.5YR 4/4) silt loam; moderate medium subangular blocky structure; friable; few roots; thin continuous clay films on faces of peds; neutral; clear wavy boundary.

IIB22t—25 to 32 inches; reddish brown (5YR 4/3) silty clay; strong medium subangular blocky structure; firm; few roots; thick continuous clay films on faces of peds; estimated 2 percent gravel; mildly alkaline; abrupt smooth boundary.

R—32 inches; light gray (10YR 7/1) dolomite; slight effervescence.

The solum is 20 to 40 inches thick. The depth to dolomite is also 20 to 40 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 4- or 5-inch A1 horizon that has value of 3 or 4 and chroma of 2 or 3. The A2 horizon is 3 to 5 inches thick and has value of 4 or 5 and chroma of 2. The IIB2t horizon is clay loam, silty clay loam, silty clay, or clay. Coarse fragments in the B horizon range from 0 to 15 percent; the highest percentage is in the IIB22t horizon.

Willette series

The Willette series consists of very poorly drained soils in depressions on till plains and in lacustrine basins. Permeability is moderately rapid in the organic layer and very slow in the substratum. These soils formed in 16 to 50 inches of muck over clayey deposits. Slopes range from 0 to 2 percent.

Willette soils are similar to Adrian and Palms soils and are adjacent to Poygan soils on the landscape. Adrian soils have a sandy substratum. Palms soils have a loamy substratum. Poygan soils are poorly drained mineral soils; they are in higher positions on the landscape surrounding Willette soils.

Typical pedon of Willette muck, 1,000 feet south and 480 feet west of NE corner of sec. 14, T. 18 N., R. 20 E. (in Calumet County):

Oa1—0 to 13 inches; black (N 2/0) broken face, pressed, and rubbed sapric material; about 9 percent fiber, 5 percent rubbed; weak fine subangular blocky structure; slightly sticky; many roots; mildly alkaline; clear wavy boundary.

Oa2—13 to 28 inches; black (10YR 2/1) broken face, pressed, and rubbed sapric material; about 5 percent fiber, 2 percent rubbed; moderate medium and coarse subangular blocky structure; sticky; common roots; mildly alkaline; clear wavy boundary.

IIC1—28 to 30 inches; dark gray (10YR 4/1) silty clay; massive; firm, sticky; about 40 percent organic material in this horizon; violent effervescence; mildly alkaline; clear wavy boundary.

IIC2—30 to 60 inches; brown (10YR 5/3) silty clay; massive; firm, sticky; violent effervescence; mildly alkaline.

The organic horizons are 16 to 51 inches thick. Some pedons have thin layers of hemic material in the subsurface tiers. Thin layers of woody peat and coarse undecomposed woody fragments are common in some pedons. The IIC horizon has value of 4 to 6 and chroma of 1 to 4. It is silty clay or clay and less commonly clay loam or sandy clay.

Wyocena Variant

The Wyocena Variant consists of well drained, moderately rapidly permeable soils on ground and end moraines. These soils formed in loamy deposits and sandy glacial till. Slopes range from 2 to 12 percent.

Wyocena Variant soils are adjacent on the landscape to Boyer and Waymor soils. Boyer soils are well drained; they are in similar positions on the landscape but have a sand and gravel C horizon. Waymor soils are well drained; they are in similar positions on the landscape but have finer textured B and C horizons.

Typical pedon of Wyocena Variant sandy loam, 2 to 6 percent slopes, 1,680 feet north and 1,390 feet east of SW corner of sec. 23, T. 21 N., R. 23 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common roots; neutral; abrupt smooth boundary.

A2—7 to 11 inches; yellowish brown (10YR 5/4) sandy loam; weak fine subangular blocky structure; very friable; common roots; neutral; clear wavy boundary.

B&A—11 to 16 inches; brown (7.5YR 4/4) sandy loam (Bt; 65 percent); weak fine subangular blocky structure; very friable; common roots; thin discontinuous clay films on faces of peds in Bt part; interfingers of yellowish brown (10YR 5/4) sandy loam (A2; 35 percent) 5 to 15 millimeters in diameter extend through this horizon; estimated 5 percent gravel; neutral; gradual irregular boundary.

B2t—16 to 24 inches; brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; thin discontinuous clay films on faces of peds; estimated 8 percent gravel; few cobblestones; neutral; clear wavy boundary.

C—24 to 60 inches; yellowish brown (10YR 5/4) loamy sand; massive; very friable; estimated 13 percent gravel; slight effervescence; mildly alkaline.

The solum is 20 to 30 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 3- to 5-inch A1 horizon that has value and chroma of 2 or 3. The A2 horizon is 6 to 8 inches thick and has value of 4 to 6 and chroma of 2 to 4. The B&A horizon is 4 to 6 inches thick and is loamy sand or sandy loam. The B2t horizon is sandy loam or loam. Coarse fragments in the solum range from 5 to 15 percent. The C horizon is loamy sand and sandy loam. Coarse fragments in the C horizon range from 5 to 15 percent.

Zurich series

The Zurich series consists of well drained, moderately permeable soils in glacial lake basins. These soils formed in silty lacustrine deposits. Slopes range from 2 to 12 percent.

Zurich soils are adjacent on the landscape to Mundelein and Nichols soils. Mundelein soils are somewhat poorly drained; they are in lower positions on the landscape in drainageways. Nichols soils are well drained and moderately well drained; they are in similar positions on the landscape but have coarser textured B and C horizons.

Typical pedon of Zurich silt loam, 2 to 6 percent slopes, 50 feet north and 1,880 feet east of SW corner of sec. 17, T. 20 N., R. 24 E. (in Manitowoc County):

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure parting to weak medium granular; friable; many fibrous roots; mildly alkaline; abrupt smooth boundary.

B2t—7 to 16 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; common roots; thin continuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

B3t—16 to 22 inches; brown (7.5YR 5/4) silt loam; weak coarse subangular blocky structure; friable; few roots; thin discontinuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

C1—22 to 25 inches; brown (7.5YR 5/4) silt loam; many medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; violent effervescence; mildly alkaline; clear wavy boundary.

C2—25 to 60 inches; brown (7.5YR 5/4) silt loam; massive; friable; violent effervescence; mildly alkaline.

The solum is 20 to 30 inches thick. The depth to free carbonates corresponds to the thickness of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Soils in uncultivated areas have a 4- or 5-inch A1 horizon that has value of 3 or 4 and chroma of 1 or 2. In some pedons there is an A2 horizon, which is 3 to 6 inches thick and has value of 4 or 5 and chroma of 2 or 3. The C horizon is dominantly silt loam and has bands of very fine sandy loam, very fine sand, or silt in some pedons.

Formation of the soils

In this section, the factors of soil formation are described, these factors are related to the formation of the soils in the survey area, and the processes of soil formation are explained.

Factors of soil formation

The factors that determine the kind of soil that forms at any given time are the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and weathered; the plant and animal life on and in the soil; the relief or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are active factors of soil formation. They alter the accumulated parent material and bring about the development of genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that can be formed. Finally, time is needed to change the parent material into a soil. Usually, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are not known.

Parent material

The parent material in Calumet and Manitowoc Counties consists of wind-laid silty and sandy material, water-deposited material, residuum of bedrock, organic residue, and glacial drift. Glacial drift consists of glacial till and outwash.

Glacial till is a mixture of soil and rock that is ground as a result of glacial action. Three distinctively different types of till occur in the survey area. They were brought in during the last two substages of the Wisconsin Age of glaciation. The two substages are called Cary and Valders. Each substage deposited glacial debris to form hills, valleys, depressions, and plains.

Two lobes of the Cary till were deposited in the survey area. One of the lobes is in the southwestern corner of Manitowoc County and extends into the southern part of Calumet County. This lobe of the Cary till is easily distinguished from the Valders and the other lobe of the Cary till by its yellowish color and its high calcium carbonate content. It is loam or sandy loam. Prominent gravel ridges, irregular hills, and wet depressions are characteristic of this lobe. Large stones are common on the soil surface. The Hochheim, Lamartine, and Theresa soils are the dominant soils on this lobe of Cary till. The other lobe of Cary till is in the northwestern part of Manitowoc County. The till in this lobe is reddish and is lower in calcium carbonate content than the till in the first lobe. It is sandy loam, loam, or clay loam. Characteristic of the topography of this lobe in the southern part are long, gentle slopes that have broad drainageways; in the northern part are short, choppy, complex slopes. Surface stones are common. The Hortonville, Symco, and Waymor soils are the dominant soils on this lobe of Cary till.

The Valders ice sheet moved on to the Cary deposits. It occupied about two-thirds of Calumet County and one-half of Manitowoc County. The Valders till is reddish and has a clayey texture. Gentle slopes and large drainageways characterize the topography. Kewaunee and Manawa soils are some of the dominant soils that formed in Valders till.

The thickness of the glacial drift ranges from a trace to more than 150 feet throughout the survey area. Channahon, Kolberg, and Whalan soils are the dominant soils that formed in a thin layer of drift over dolomite bedrock (fig. 13). These soils are scattered throughout the survey area. The topography in areas of these soils is controlled by the underlying dolomite bedrock. The soils are mostly gently sloping or sloping. Many areas have dolomite outcrops and escarpments.

Melt water of the receding ice masses deposited outwash sand and gravel on the watercourses in the form of river terraces, eskers, kames, and outwash plains. The topography of these outwash deposits ranges from nearly level to steep. Gravel and cobblestones are common on the surface in many areas. The dominant soils that formed in outwash are Boyer and Lutzke soils.

Extinct glacial lake basins have stratified deposits of silt, clay, and fine sand. The topography is nearly level and gently sloping. The Briggsville and Zurich soils are the dominant soils that formed in the stratified deposits. These soils are almost free of stones.

In about one-third of the survey area, a thin layer of wind-laid silt loam covers the glacial drift. Because this layer is thin, many of the soils in this part of the survey area developed partly in the underlying glacial drift. The Dodge, Lamartine, Symco, and Theresa soils are the dominant soils that formed in wind-laid silt loam and in the underlying glacial drift.

Deposits of organic residue occur throughout the survey area. These deposits consist of partly decomposed reeds, sedges, grasses, and trees. The topography is nearly level. The dominant soils that formed in organic residue are the Adrian, Houghton, Palms, and Willette soils.

Climate

In general, climate affects soil formation through the moisture and heat that it contributes to the environment. It has a direct effect on the weathering of rocks and the alteration of parent material through freezing and thaw-

Figure 13.—In this area a trace of drift overlies Niagara Dolomite, which formed in layers.

ing. The leaching by water affects soil formation and movement of clay in soils. Climate has an indirect effect through its influence on plants and animal life.

The climate is nearly uniform throughout the survey area and has caused few of the differences among the soils. The cooler microclimate near Lake Michigan has caused some minor differences.

Plant and animal life

Plants and animals affect the formation of soils by providing organic matter and by transferring plant nutrients from the lower layers of soil to the upper layers.

Most of the soils in Calumet and Manitowoc Counties formed under deciduous forest vegetation. Soils that formed under forest vegetation have a thin, light-colored surface layer. These soils are classified as Alfisols; examples are the Hortonville, Kewaunee, and Waymor soils. A few of the soils in Calumet and Manitowoc Counties formed under grass vegetation. Soils that formed under grass vegetation have a thick, dark-colored surface layer. These soils are classified as Mollisols; examples are the Brookston, Poygan, and Wauseon soils.

Man's activity has had an important but recent influence on the soils. Man has greatly altered the original condition of the soils by clearing the original vegetation and mixing the upper soil layers by cultivation. He then planted crops, which were different from the original vegetation. He has drained large areas, changing the natural drainage of many of the soils. He has overcultivated the soils with heavy equipment; this resulted in the loss of organic matter, compaction, and erosion of the surface layer. Examples of this overcultivation are shown in the eroded map units of the Hortonville, Kewaunee, and Waymor soils. Some of the effects of man's activities such as the adding of fertilizers and pesticides may not be known for many years.

Relief

The drainage of soils is mostly determined by relief and by the position of the soils on the landscape. The relief in Calumet and Manitowoc Counties ranges from steep in the morainic areas to nearly level on the bottom lands.

Soils that remain wet in depressions are mottled throughout their profiles. Because decomposition of organic matter is slow in wet soils, they have a thick surface layer that is high in content of organic matter. Brookston, Pella, and Poygan soils are examples.

Soils that formed in alluvium occur near streams and rivers. These are young soils that have indistinct horizons because they receive fresh deposits of sand, silt, or clay at a faster rate than horizons can develop. As a result these soils do not have the distinct horizons characteristic of the more mature soils.

Typical of the older soils on the uplands are Hochheim, Hortonville, and Kewaunee soils. These soils have distinct horizons in the surface layer and subsoil, although erosion has removed part of the surface layer on many soils.

Time

Time is needed for the parent material to change into soil. Time is always needed for horizonation. Soil is considered well developed, poorly developed, or somewhere in between, depending on the length of time the soil forming factors have been active. The Hortonville and Kewaunee soils have moderately distinct horizons and are considered to be well developed. Soils that formed in recent alluvium show little profile development. A few soils such as Nichols and Shiocton soils are young but are older than the soils that formed in recent alluvium. They have at least one distinct horizon.

Horizon differentiation

Horizons are differentiated in a soil as a result of the action of certain basic soil-forming processes. There are four main processes: gains, losses, transfers, and transformations, and they generally do not act alone. Some changes promote and others retard or offset horizon differentiation. The balance among changes determines the nature of the soil at any given point.

Dodge soils are an example of how these soil-forming processes interact. The parent material of these soils was calcareous loam till and windblown silt loam. The silt loam was probably deposited over the till during and after the glacial period. Because these soils are high on the landscape and are underlain by porous till, they are well drained. The climate was favorable for the growth of plants. Plants and animals contributed to the accumulation of organic matter and organic acids, and they mixed the soil. These processes accelerated as more and higher forms of organisms grew in the soil and produced a greater volume of organic residue and acids.

As a result of these soil-forming processes, the Dodge soils now have a surface layer of silt loam and a subsoil that is silty clay loam in the upper part and is dark yellowish brown clay loam and sandy clay loam in the lower part. These soils are underlain at a depth of about 37 inches by unweathered, mildly alkaline till that has changed little since it was deposited by the glacier.

Processes that took place in the formation of Dodge soils were gains of organic matter in the surface layer, loss of clay from the upper part of the soil and subsequent transfer to the lower part of the subsoil, and transformation of iron compounds in the lower part of the subsoil.

All these processes are active in all soils of the survey area. In Calumet and Manitowoc Counties, the kinds of parent material and relief have helped determine the kinds of processes that are dominant in the formation of all the soils, and they have caused differences among the soils.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth, soil. The depth, in inches, to a root-impeding layer or horizon. In this survey area, soils that are 10 to 20 inches deep are classified as *shallow*, and soils that are 20 to 40 inches deep are classified as *moderately deep*.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops

cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material mixed with mineral soil material. The content of organic matter is more than 20 percent.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Organic matter. Plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition. Classes and percentages of organic matter in the surface layer of the mineral soils are: very low (less than 0.5), low (0.5 to 1.0), moderately low (1.0 to 2.0), moderate (2.0 to 4.0), high (4.0 to 8.0), very high (over 8.0).

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated with water. To have all of the voids between soil particles filled with water.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope symbol, percent of slope, and slope class of the soils in Calumet and Manitowoc Counties are as follows: A, 0 to 2 percent, nearly level; B, 2 to 6 percent, gently sloping; C, 6 to 12 percent, sloping; D, 12 to 20 percent, moderately steep; and E, 20 to 30 percent, steep. For some of the soils on the lower end of the slope range and some of those on the upper end, the slope groups differ slightly from these groups. Soils that have no slope symbol are nearly level.

Slow intake. The slow movement of water into the soil.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration, and decomposition of the material.

Well graded. Refers to the soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data from Chilton, Wisconsin. Period of record 1930-1959. Some data interpolated from Appleton records]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have monthly average: Equal to or higher than--	2 years in 10 will have monthly average: Equal to or lower than--	Average monthly total	1 year in 10 will have--: Less than--	1 year in 10 will have--: More than--	Days with 0.1 inch or more precipitation	Average snowfall
	°F	°F	°F	°F	In	In	In		In
January---	27.2	9.0	24	12	1.13	0.31	2.49	3	8.6
February--	30.1	11.2	27	15	1.26	0.42	3.58	4	9.2
March-----	40.2	21.8	33	24	1.80	0.81	3.39	5	9.5
April-----	56.8	34.6	51	38	2.86	0.77	4.85	6	1.5
May-------	68.6	43.0	62	50	2.81	0.84	4.62	7	1/
June------	78.2	53.5	69	61	3.77	2.22	5.83	8	0
July------	82.4	58.5	74	68	3.54	1.08	6.76	6	0
August----	82.0	57.9	72	66	3.28	2.02	4.81	6	0
September-	73.7	49.6	64	57	2.86	0.70	5.65	6	0
October---	63.1	40.4	55	46	2.06	0.27	5.33	4	0.3
November--	43.7	27.4	40	29	2.32	0.34	4.69	5	5.9
December--	30.7	15.1	28	16	1.55	0.96	2.31	4	8.8
Year---	56.4	35.2			29.24	22.01	33.91	64	43.8

1/Trace, an amount too small to measure.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data from Chilton and Appleton, Wisconsin. Period of record 1930-1959]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
2 years in 10 later than--	Mar. 31	Apr. 9	Apr. 26	May 11	May 27
4 years in 10 later than--	Mar. 23	Apr. 2	Apr. 18	May 4	May 20
6 years in 10 later than--	Mar. 17	Mar. 26	Apr. 12	Apr. 28	May 14
8 years in 10 later than--	Mar. 9	Mar. 18	Apr. 5	Apr. 21	May 7
Fall:					
2 years in 10 earlier than-	Nov. 5	Oct. 28	Oct. 14	Sep. 30	Sep. 22
4 years in 10 earlier than-	Nov. 13	Nov. 5	Oct. 21	Oct. 8	Sep. 29
6 years in 10 earlier than-	Nov. 19	Nov. 11	Oct. 28	Oct. 14	Oct. 5
8 years in 10 earlier than-	Nov. 27	Nov. 19	Nov. 5	Oct. 22	Oct. 12

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Calumet County	Manitowoc County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
Ac	Adrian muck	16	2,150	2,166	0.3
As	Aquents, sloping	220	515	735	0.1
BcA	Bellevue silt loam, 0 to 3 percent slopes	840	980	1,820	0.3
BrB	Boyer sandy loam, 2 to 6 percent slopes	700	8,900	9,600	1.5
BrC2	Boyer sandy loam, 6 to 12 percent slopes, eroded	200	3,300	3,500	0.6
BsB	Boyer sandy loam, loamy substratum, 2 to 6 percent slopes	24	940	964	0.2
BtB	Briggsville silt loam, 2 to 6 percent slopes	432	2,450	2,882	0.5
BtC2	Briggsville silt loam, 6 to 12 percent slopes, eroded	0	363	363	*
Bu	Brookston silt loam	1,300	4,550	5,850	0.9
CnB	Channahon loam, 2 to 6 percent slopes	1,700	600	2,300	0.4
CnC	Channahon loam, 6 to 12 percent slopes	1,050	344	1,394	0.2
CoA	Cosad loamy fine sand, 0 to 3 percent slopes	184	2,600	2,784	0.4
DoB	Dodge silt loam, 2 to 6 percent slopes	4,250	500	4,750	0.8
Du	Dune land	0	268	268	*
Fu	Fluvaquents	1,300	5,000	6,300	1.0
Gb	Granby fine sandy loam	430	5,800	6,230	1.0
HmB	Hochheim loam, 2 to 6 percent slopes	19,100	7,100	26,200	4.2
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	5,600	1,400	7,000	1.1
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded	1,100	710	1,810	0.3
HnB	Hochheim-Nichols-Boyer complex, 2 to 6 percent slopes	0	550	550	0.1
HnC2	Hochheim-Nichols-Boyer complex, 6 to 12 percent slopes, eroded	0	1,050	1,050	0.2
HnD	Hochheim-Boyer-Nichols complex, 12 to 25 percent slopes	0	394	394	0.1
HrB	Hortonville silt loam, 2 to 6 percent slopes	216	33,250	33,466	5.3
HrC2	Hortonville silt loam, 6 to 12 percent slopes, eroded	56	8,800	8,856	1.4
HrD2	Hortonville silt loam, 12 to 20 percent slopes, eroded	10	3,550	3,560	0.6
Hu	Houghton muck	10,400	18,600	29,000	4.6
Ke	Keowns very fine sandy loam	580	3,900	4,480	0.7
KnB	Kewaunee loam, 2 to 6 percent slopes	46,500	70,000	116,500	18.5
KnC2	Kewaunee loam, 6 to 12 percent slopes, eroded	3,850	11,600	15,450	2.5
KnD2	Kewaunee loam, 12 to 20 percent slopes, eroded	1,400	4,800	6,200	1.0
KnE	Kewaunee loam, 20 to 30 percent slopes	272	1,450	1,722	0.3
KpB	Kewaunee-Boyer-Nichols complex, 2 to 6 percent slopes	20	1,300	1,320	0.2
KpC2	Kewaunee-Boyer-Nichols complex, 6 to 12 percent slopes, eroded	0	640	640	0.1
KpD	Kewaunee-Boyer-Nichols complex, 12 to 20 percent slopes	30	1,450	1,480	0.2
KrB	Kolberg loam, 2 to 6 percent slopes	408	1,200	1,608	0.3
KrC2	Kolberg loam, 6 to 12 percent slopes, eroded	131	650	781	0.1
LmA	Lamartine silt loam, 0 to 3 percent slopes	9,200	2,200	11,400	1.8
LuB	Lutzke sandy loam, 2 to 6 percent slopes	424	3,300	3,724	0.6
LuC2	Lutzke sandy loam, 6 to 12 percent slopes, eroded	288	1,150	1,438	0.2
LuD	Lutzke sandy loam, 12 to 20 percent slopes	72	1,200	1,272	0.2
MbA	Manawa silt loam, 0 to 3 percent slopes	43,750	31,000	74,750	11.9
McB	Manawa-Kewaunee-Poygan complex, 0 to 4 percent slopes	3,900	16,400	20,300	3.2
MlA	Mayville silt loam, 1 to 3 percent slopes	8,100	960	9,060	1.4
MsA	Mosel loam, 0 to 3 percent slopes	1,100	5,000	6,100	1.0
MuA	Mundelein silt loam, 0 to 3 percent slopes	740	7,100	7,840	1.2
NsB	Nichols very fine sandy loam, 2 to 6 percent slopes	40	6,500	6,540	1.0
NsC2	Nichols very fine sandy loam, 6 to 12 percent slopes, eroded	8	1,500	1,508	0.2
OaB	Oakville loamy fine sand, 2 to 6 percent slopes	16	5,700	5,716	0.9
OaC	Oakville loamy fine sand, 6 to 12 percent slopes	0	580	580	0.1
OgB	Oakville-Granby complex, 0 to 4 percent slopes	0	1,100	1,100	0.2
OzC2	Omro loam, 4 to 12 percent slopes, eroded	0	584	584	0.1
Pa	Palms muck	2,100	6,700	8,800	1.4
Pe	Pella silt loam	6,800	5,200	12,000	1.9
Pg	Pits, gravel	120	850	970	0.2
Ph	Pits, quarries	48	100	148	*
PlB	Plainfield loamy sand, 2 to 6 percent slopes	0	2,100	2,100	0.3
PlC	Plainfield loamy sand, 6 to 12 percent slopes	0	1,050	1,050	0.2
PlD	Plainfield loamy sand, 12 to 20 percent slopes	0	200	200	*
Po	Poygan silty clay loam	12,100	13,500	25,600	4.1
ShA	Shiocton very fine sandy loam, 0 to 3 percent slopes	860	9,100	9,960	1.6
SyA	Symco silt loam, 0 to 3 percent slopes	368	13,400	13,768	2.2
TeA	Tedrow loamy fine sand, 0 to 3 percent slopes	16	4,400	4,416	0.7
ThB	Theresa silt loam, 2 to 6 percent slopes	5,600	112	5,712	0.9
TuB	Tustin loamy fine sand, 2 to 6 percent slopes	18	2,300	2,318	0.4
Ud	Udorthents	250	300	550	0.1

See footnote at end of table.

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Calumet County	Manitowoc County	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
WaA	Wasepi sandy loam, 0 to 3 percent slopes	770	4,700	5,470	0.9
We	Wauseon sandy loam	224	2,150	2,374	0.4
WoB	Waymor silt loam, 2 to 6 percent slopes	160	2,000	2,160	0.3
WoC2	Waymor silt loam, 6 to 12 percent slopes, eroded	0	1,000	1,000	0.2
WoD2	Waymor silt loam, 12 to 20 percent slopes, eroded	0	1,000	1,000	0.2
WpB	Whalan silt loam, 2 to 6 percent slopes	2,350	328	2,678	0.4
Wt	Willette muck	4,350	3,000	7,350	1.2
WvB	Wyocena Variant sandy loam, 2 to 6 percent slopes	5	850	855	0.1
WvC2	Wyocena Variant sandy loam, 6 to 12 percent slopes, eroded	0	248	248	*
ZuB	Zurich silt loam, 2 to 6 percent slopes	240	6,500	6,740	1.0
ZuC2	Zurich silt loam, 6 to 12 percent slopes, eroded	0	328	328	*
	Water	45,184	896	46,080	7.3
	Total	251,520	378,240	629,760	100.0

* Less than 0.1 percent.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	Ton	Bu	Ton	AUM*
Ac----------------------- Adrian	---	10	---	---	---
As. Aquents					
BcA---------------------- Bellevue	100	16	70	---	3.0
BrB---------------------- Boyer	80	13	60	3.4	2.7
BrC2--------------------- Boyer	75	12	55	2.8	2.5
BsB---------------------- Boyer	80	13	60	3.5	2.7
BtB---------------------- Briggsville	110	15	70	3.5	3.0
BtC2--------------------- Briggsville	90	13	60	4.0	2.7
Bu----------------------- Brookston	100	15	60	3.5	---
CnB---------------------- Channahon	61	10	45	2.8	2.2
CnC---------------------- Channahon	55	9	37	2.5	2.0
CoA---------------------- Cosad	85	17	75	3.0	3.0
DoB---------------------- Dodge	105	19	75	4.5	3.0
Du. Dune land					
Fu. Fluvaquents					
Gb----------------------- Granby	60	8	45	3.0	2.5
HmB---------------------- Hochheim	90	14	65	4.0	3.0
HmC2--------------------- Hochheim	80	13	55	3.5	2.7
HmD2--------------------- Hochheim	65	11	45	3.0	2.5
HnB---------------------- Hochheim-Nichols-Boyer	88	14	64	3.8	3.0
HnC2--------------------- Hochheim-Nichols-Boyer	80	12	56	3.2	2.7
HnD---------------------- Hochheim-Boyer-Nichols	---	---	50	2.5	2.5

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	Ton	Bu	Ton	AUM*
HrB----------------------- Hortonville	110	17	70	4.5	4.0
HrC2---------------------- Hortonville	100	16	65	4.0	4.0
HrD2---------------------- Hortonville	85	14	55	3.5	3.5
Hu------------------------ Houghton	---	17	---	---	---
Ke------------------------ Keowns	---	15	60	3.5	3.0
KnB----------------------- Kewaunee	110	18	80	5.0	3.0
KnC2---------------------- Kewaunee	100	17	75	4.5	2.7
KnD2---------------------- Kewaunee	95	16	60	4.5	2.5
KnE----------------------- Kewaunee	---	---	40	3.7	2.3
KpB----------------------- Kewaunee-Boyer-Nichols	97	15	71	4.3	2.9
KpC2---------------------- Kewaunee-Boyer-Nichols	90	16	67	3.9	2.7
KpD----------------------- Kewaunee-Boyer-Nichols	80	14	55	3.5	2.5
KrB----------------------- Kolberg	80	13	65	3.7	3.0
KrC2---------------------- Kolberg	65	11	55	3.0	2.6
LmA----------------------- Lamartine	115	18	65	4.0	3.0
LuB----------------------- Lutzke	50	10	45	2.4	2.7
LuC2---------------------- Lutzke	45	8	40	2.1	2.2
LuD----------------------- Lutzke	---	---	35	1.6	2.0
MbA----------------------- Manawa	90	17	75	4.5	3.0
McB----------------------- Manawa-Kewanee-Poygan	97	18	75	4.5	3.0
MlA----------------------- Mayville	110	17	70	4.5	3.0
MsA----------------------- Mosel	105	17	60	4.5	3.0
MuA----------------------- Mundelein	123	18	79	5.0	3.0

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	Ton	Bu	Ton	AUM*
NsB----------------------- Nichols	100	17	65	3.5	3.0
NsC2---------------------- Nichols	90	14	60	3.5	2.8
OaB----------------------- Oakville	50	8	48	2.0	2.0
OaC----------------------- Oakville	---	---	35	1.8	1.8
OgB----------------------- Oakville-Granby	50	8	48	2.5	2.0
OzC2---------------------- Omro	85	14	70	5.0	3.0
Pa------------------------ Palms	---	17	---	---	---
Pe------------------------ Pella	---	17	60	4.0	---
Pg, Ph. Pits					
PlB----------------------- Plainfield	40	6	35	2.0	1.0
PlC----------------------- Plainfield	---	---	30	1.7	1.0
PlD----------------------- Plainfield	---	---	---	---	0.8
Po------------------------ Poygan	100	17	65	4.0	3.0
ShA----------------------- Shiocton	100	17	55	3.0	3.0
SyA----------------------- Symco	90	15	65	4.0	3.0
TeA----------------------- Tedrow	55	8	50	3.2	3.0
ThB----------------------- Theresa	105	17	75	4.5	3.5
TuB----------------------- Tustin	70	10	50	2.5	3.0
Ud. Udorthents					
WaA----------------------- Wasepi	80	12	60	3.0	2.5
We------------------------ Wauseon	80	16	60	3.0	---
WoB----------------------- Waymor	115	19	75	4.5	3.0
WoC2---------------------- Waymor	90	16	60	4.0	2.7
WoD2---------------------- Waymor	80	14	50	3.5	2.5

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Corn silage	Oats	Grass-legume hay	Kentucky bluegrass
	Bu	Ton	Bu	Ton	AUM*
WpB Whalan	80	12	60	4.0	3.0
Wt Willette	---	13	---	---	---
WvB Wyocena Variant	75	13	60	3.0	3.3
WvC2 Wyocena Variant	70	12	55	2.7	3.0
ZuB Zurich	102	17	63	4.3	4.0
ZuC2 Zurich	99	16	59	4.1	3.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 5.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	16,900	---	---	---
II	390,856	211,128	179,728	---
III	88,395	50,257	27,574	10,564
IV	73,756	17,524	47,316	8,916
V	7,035	---	7,035	---
VI	4,624	2,994	---	1,630
VII	200	---	---	200
VIII	---	---	---	---

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
Ac------------------ Adrian	3w	Severe	Severe	Severe	Severe	Tamarack------------ Red maple----------- Silver maple-------- White ash----------- Quaking aspen-------	49 --- --- --- ---	Silver maple, red maple, northern white-cedar, black spruce.
BcA----------------- Bellevue	3o	Slight	Slight	Slight	Slight	Northern red oak---- Sugar maple---------	58 ---	Eastern white pine, red pine, white spruce.
BrB, BrC2----------- Boyer	3o	Slight	Slight	Slight	Moderate	Northern red oak---- White oak-----------	58 ---	Eastern white pine, red pine.
BsB----------------- Boyer	3o	Slight	Slight	Slight	Slight	Northern red oak---- Northern pin oak---- White oak-----------	55 --- ---	Red pine, eastern white pine, jack pine.
BtB, BtC2----------- Briggsville	2c	Slight	Slight	Slight	Moderate	Northern red oak---- Sugar maple--------- White ash----------- American basswood---	65 --- --- ---	Eastern white pine, white spruce, red pine.
Bu------------------ Brookston	4w	Severe	Severe	Moderate	Severe	Silver maple-------- Red maple----------- White ash-----------	70 --- ---	Eastern white pine, white spruce, red maple, white ash.
CnB, CnC------------ Channahon	3d	Slight	Moderate	Moderate	Slight	Northern red oak---- White oak----------- Shagbark hickory----	55 --- ---	Eastern white pine, red pine.
CoA----------------- Cosad	4w	Moderate	Moderate	Moderate	Moderate	Red maple----------- Eastern white pine--	45 ---	White spruce, eastern white pine.
DoB----------------- Dodge	2o	Slight	Slight	Slight	Moderate	Northern red oak---- Black cherry-------- White oak-----------	65 --- ---	Eastern white pine, red pine, white spruce.
Gb------------------ Granby	3w	Severe	Severe	Severe	Severe	White ash----------- Quaking aspen------- Silver maple-------- Red maple-----------	55 --- --- ---	White spruce, white ash, red maple.
HmB, HmC2----------- Hochheim	2o	Slight	Slight	Slight	Moderate	Sugar maple--------- American basswood--- Northern red oak---- White ash-----------	58 --- --- ---	Red pine, eastern white pine.
HmD2---------------- Hochheim	2r	Moderate	Slight	Slight	Moderate	Sugar maple--------- American basswood--- Northern red oak---- White ash-----------	58 --- --- ---	Red pine, eastern white pine.
HnB*, HnC2*:								
Hochheim-----------	2o	Slight	Slight	Slight	Moderate	Sugar maple--------- American basswood--- Northern red oak---- White ash-----------	58 --- --- ---	Red pine, eastern white pine.

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
HnB*, HnC2*:								
Nichols	1o	Slight	Slight	Slight	Moderate	Sugar maple	66	Red pine, eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						White oak	---	
Boyer	3o	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine.
						White oak	---	
HnD*:								
Hochheim	2r	Moderate	Slight	Slight	Moderate	Sugar maple	58	Red pine, eastern white pine.
						American basswood	---	
						Northern red oak	---	
						White ash	---	
Boyer	3o	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine.
						White oak	---	
Nichols	1r	Moderate	Moderate	Slight	Slight	Sugar maple	66	Red pine, eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						White oak	---	
HrB, HrC2 Hortonville	2o	Slight	Slight	Slight	Moderate	Northern red oak	65	Eastern white pine, red pine, white spruce.
						Sugar maple	---	
						American basswood	---	
HrD2 Hortonville	1r	Moderate	Slight	Slight	Moderate	Northern red oak	70	Eastern white pine, red pine, white spruce.
						Sugar maple	63	
						American basswood	---	
Hu Houghton	3w	Severe	Severe	Severe	Severe	Tamarack	48	Silver maple, red maple, northern white-cedar, black spruce.
						Red maple	---	
						Silver maple	---	
						White ash	---	
						Quaking aspen	---	
						Northern white-cedar	---	
Ke Keowns	1w	Severe	Moderate	Moderate	Severe	Silver maple	95	Silver maple, red maple, white ash.
						Red maple	---	
						White ash	---	
KnB, KnC2 Kewaunee	2c	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple	---	
						White ash	---	
						American basswood	---	
KnD2, KnE Kewaunee	2c	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple	---	
						White ash	---	
						American basswood	---	
KpB*, KpC2*:								
Kewaunee	2c	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine, white spruce.
						Sugar maple	---	
						White ash	---	
						American basswood	---	
Boyer	3o	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine, red pine.
						White oak	---	
Nichols	1o	Slight	Slight	Slight	Moderate	Sugar maple	66	Red pine, eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						White oak	---	

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
KpD*:								
Kewaunee	2c	Moderate	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine,
						Sugar maple	---	red pine,
						White ash	---	white spruce.
						American basswood	---	
Boyer	3o	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine,
						White oak	---	red pine.
Nichols	1r	Moderate	Moderate	Slight	Slight	Sugar maple	66	Red pine, eastern
						Northern red oak	---	white pine, white
						American basswood	---	spruce.
						White oak	---	
KrB, KrC2 Kolberg	2c	Slight	Slight	Slight	Moderate	Northern red oak	69	Eastern white pine,
						Sugar maple	63	red pine,
						White ash	---	white spruce.
						American basswood	---	
LmA Lamartine	2o	Slight	Slight	Slight	Moderate	Northern red oak	65	Eastern white pine,
						American basswood	---	red pine, white
						Sugar maple	---	spruce.
LuB, LuC2 Lutzke	4f	Slight	Moderate	Slight	Slight	Northern pin oak	49	Eastern white pine,
						Black oak	---	jack pine,
						White oak	---	red pine.
LuD Lutzke	4f	Moderate	Moderate	Slight	Slight	Northern pin oak	49	Eastern white pine,
						Black oak	---	jack pine,
						White oak	---	red pine.
MbA Manawa	2c	Slight	Slight	Slight	Moderate	Sugar maple	50	Red maple,
						American beech	---	green ash,
						Green ash	52	white ash,
						Red maple	52	white spruce.
McB*:								
Manawa	2c	Slight	Slight	Slight	Moderate	Sugar maple	50	Red maple,
						American beech	---	green ash,
						Green ash	52	white ash,
						Red maple	52	white spruce.
Kewaunee	2c	Slight	Slight	Slight	Moderate	Northern red oak	66	Eastern white pine,
						Sugar maple	---	red pine,
						White ash	---	white spruce.
						American basswood	---	
Poygan	2w	Severe	Severe	Moderate	Severe	White ash	65	White spruce,
						Red maple	---	black spruce.
MlA Mayville	2o	Slight	Slight	Slight	Moderate	Northern red oak	65	Red pine,
						White ash	---	eastern white pine,
						American basswood	---	white spruce.
						White oak	---	
						Silver maple	---	
						Bitternut hickory	---	
MsA Mosel	2o	Slight	Slight	Slight	Moderate	Northern red oak	65	Eastern white pine,
						American basswood	---	red pine,
						Red maple	---	white spruce.
MuA Mundelein	4o	Slight	Slight	Slight	Slight	Northern red oak	49	Eastern white pine,
						Sugar maple	---	red pine, white
						American basswood	---	spruce.
						Shagbark hickory	---	

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
NsB, NsC2: Nichols	1o	Slight	Slight	Slight	Moderate	Sugar maple	66	Red pine, eastern white pine, white spruce.
						Northern red oak	---	
						American basswood	---	
						White oak	---	
OaB, OaC: Oakville	2s	Slight	Severe	Slight	Moderate	Northern red oak	66	Red pine, eastern white pine, jack pine.
						White oak	---	
						Red pine	---	
						Quaking aspen	---	
						Black oak	---	
OgB*:								
Oakville	2s	Slight	Severe	Slight	Moderate	Northern pin oak	52	Red pine, eastern white pine, jack pine.
						White oak	---	
						Red pine	---	
						Quaking aspen	---	
						Black oak	---	
Granby	3w	Severe	Severe	Severe	Severe	White ash	55	Eastern white pine, white spruce, white ash, red maple.
						White pine	---	
						Quaking aspen	---	
						Silver maple	---	
						Northern red oak	---	
						Pin oak	---	
						Red maple	---	
						American sycamore	---	
						Eastern cottonwood	---	
						Eastern white pine	---	
OzC2: Omro	2c	Slight	Severe	Severe	Moderate	Northern red oak	65	Eastern white pine, red pine, white spruce.
						Sugar maple	---	
						White ash	---	
						Red maple	---	
Pa: Palms	3w	Severe	Severe	Severe	Severe	Red maple	55	
						Silver maple	---	
						White ash	---	
						Quaking aspen	---	
Pe: Pella	3w	Severe	Severe	Moderate	Severe	White ash	55	Northern white-cedar, white spruce, tamarack, black spruce, pin oak, green ash.
						Northern white-cedar	---	
						American elm	---	
						Silver maple	---	
PlB, PlC: Plainfield	3s	Slight	Severe	Slight	Moderate	Red pine	55	Red pine, eastern white pine, jack pine.
						Eastern white pine	---	
						Jack pine	---	
						Northern pin oak	---	
PlD: Plainfield	3s	Severe	Severe	Slight	Moderate	Red pine	55	Red pine, eastern white pine, jack pine.
						Eastern white pine	---	
						Jack pine	---	
						Northern pin oak	---	
Po: Poygan	2w	Severe	Severe	Moderate	Severe	White ash	65	White spruce, black spruce.
						Red maple	---	
ShA: Shiocton	2o	Slight	Slight	Slight	Moderate	Red maple	65	Eastern white pine, white spruce, silver maple, white ash.
						Sugar maple	---	
						Northern red oak	---	
						American basswood	---	
						American beech	---	

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Important trees	Site index	Trees to plant
SyA---------------- Symco	1o	Slight	Slight	Slight	Moderate	Northern red oak---- Red maple----------- Silver maple-------- White ash----------- Green ash----------- Eastern white pine--	75 --- --- --- --- ---	Red maple, silver maple, white ash, green ash.
TeA---------------- Tedrow	3w	Moderate	Moderate	Moderate	Slight	White ash----------- Silver maple-------- Eastern white pine--	55 --- ---	White ash, silver maple, white spruce.
ThB---------------- Theresa	1o	Slight	Slight	Slight	Moderate	Northern red oak---- Sugar maple--------- American basswood---	72 --- ---	Red pine, eastern white pine, white spruce.
TuB---------------- Tustin	3o	Slight	Slight	Slight	Moderate	Black oak----------- Red pine------------ Eastern white pine--	55 54 54	Red pine, eastern white pine.
WaA---------------- Wasepi	3o	Slight	Slight	Slight	Moderate	White ash----------- Quaking aspen------- Paper birch--------- Northern red oak---- White oak----------- Silver maple--------	55 --- --- --- --- ---	White spruce, eastern white pine, eastern cottonwood.
We----------------- Wauseon	3w	Severe	Severe	Severe	Severe	White ash----------- Swamp white oak----- Silver maple--------	60 --- ---	White spruce, silver maple, white ash.
WoB, WoC2---------- Waymor	1o	Slight	Slight	Slight	Moderate	Northern red oak---- Sugar maple--------- White ash----------- American basswood---	78 --- --- ---	Eastern white pine, red pine, white spruce.
WoD2--------------- Waymor	1r	Moderate	Slight	Slight	Moderate	Northern red oak---- Sugar maple--------- White ash----------- American basswood---	78 --- --- ---	Eastern white pine, red pine, white spruce.
WpB---------------- Whalan	2o	Slight	Slight	Slight	Severe	Northern red oak---- White oak-----------	65 60	Eastern white pine, red pine.
Wt----------------- Willette	3w	Severe	Severe	Severe	Severe	Northern white-cedar Tamarack------------ Red maple----------- White ash-----------	35 --- --- ---	---
WvB, WvC2---------- Wyocena Variant	3o	Slight	Slight	Slight	Slight	Northern pin oak----	52	Red pine, jack pine.
ZuB, ZuC2---------- Zurich	1o	Slight	Slight	Slight	Moderate	Northern red oak---- White oak----------- Sugar maple---------	75 --- ---	Eastern white pine, red pine, white spruce.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ac. Adrian	Silky dogwood	Northern white-cedar.	---	---	---
As*. Aquents	---	---	---	---	---
BcA. Bellevue	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
BrB, BrC2. Boyer	Silky dogwood	Common ninebark, lilac.	Norway spruce	Eastern white pine, red pine.	---
BsB. Boyer	---	Northern white-cedar, common ninebark, lilac, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
BtB, BtC2. Briggsville	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Bu. Brookston	---	Silky dogwood, lilac, nannyberry viburnum.	White spruce, northern white-cedar.	Eastern white pine.	---
CnB, CnC. Channahon	Autumn-olive	Russian-olive	White spruce, eastern redcedar, Norway spruce.	Red pine, eastern white pine.	---
CoA. Cosad	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
DoB. Dodge	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Du*. Dune land	---	---	---	---	---
Fu*. Fluvaquents	---	---	---	---	---
Gb. Granby	---	Silky dogwood	White spruce	Eastern white pine, white ash, red maple, silver maple.	---
HmB, HmC2, HmD2. Hochheim	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
HnB*, HnC2*:					
Hochheim	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
HnB*, HnC2*:					
Nichols	---	Lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Boyer	Silky dogwood	Common ninebark, lilac.	Norway spruce	Eastern white pine, red pine.	---
HnD*:					
Hochheim	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Boyer	Silky dogwood	Common ninebark, lilac.	Norway spruce	Eastern white pine, red pine.	---
Nichols	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
HrB, HrC2, HrD2 Hortonville	---	Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Hu Houghton	---	Silky dogwood.	Northern white-cedar.	---	Norway poplar.
Ke Keowns	---	Northern white-cedar, redosier dogwood, nannyberry viburnum.	Green ash, white spruce.	Eastern white pine, jack pine, silver maple.	---
KnB, KnC2, KnD2, KnE Kewaunee	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
KpB*, KpC2*, KpD*:					
Kewaunee	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Boyer	Silky dogwood	Common ninebark, lilac.	Norway spruce	Eastern white pine, red pine.	---
Nichols	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
KrB, KrC2--------- Kolberg	---	Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
LmA--------------- Lamartine	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
LuB, LuC2, LuD---- Lutzke	---	Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
MbA--------------- Manawa	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
McB*:					
Manawa-----------	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Kewaunee---------	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Poygan-----------	---	Silky dogwood, northern white-cedar.	White spruce------	Eastern white pine.	---
MlA--------------- Mayville	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
MsA--------------- Mosel	---	Northern white-cedar, nannyberry viburnum, redosier dogwood.	White spruce, green ash.	Eastern white pine, jack pine, silver maple.	---
MuA--------------- Mundelein	---	Autumn-olive, lilac, silky dogwood.	White spruce------	Eastern white pine.	---
NsB, NsC2--------- Nichols	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
OaB, OaC---------- Oakville	---	Lilac, silky dogwood.	Norway spruce-----	Eastern white pine, red pine.	---
OgB*:					
Oakville---------	---	Lilac, silky dogwood.	Norway spruce-----	Eastern white pine, red pine.	---
Granby-----------	---	Silky dogwood-----	White spruce------	Eastern white pine, white ash, red maple, silver maple.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
OzC2 Omro	---	Northern white-cedar, common ninebark, silky dogwood, lilac.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
Pa Palms	---	Silky dogwood	Northern white-cedar.	---	Norway poplar.
Pe Pella	---	Silky dogwood	Northern white-cedar, white spruce.	Eastern white pine.	Norway poplar.
Pg*, Ph* Pits	---	---	---	---	---
PlB, PlC, PlD Plainfield	---	Lilac, silky dogwood, Siberian peashrub.	Norway spruce	Eastern white pine, red pine, jack pine.	---
Po Poygan	---	Silky dogwood	Northern white-cedar.	Eastern white pine.	---
ShA Shiocton	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
SyA Symco	---	Northern white-cedar, redosier dogwood, nannyberry viburnum.	White spruce, green ash.	Eastern white pine, red pine, silver maple.	---
TeA Tedrow	---	Silky dogwood, gray dogwood, redosier dogwood, American cranberrybush.	Northern white-cedar.	Eastern white pine.	---
ThB Theresa	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
TuB Tustin	---	Lilac, silky dogwood, common ninebark.	White spruce	Eastern white pine, red pine.	---
Ud* Udorthents	---	---	---	---	---
WaA Wasepi	---	Silky dogwood	White spruce	Red pine, eastern white pine.	Norway poplar.
We Wauseon	---	Silky dogwood	Northern white-cedar.	Eastern white pine.	---
WoB, WoC2, WoD2 Waymor	---	Northern white-cedar, lilac, common ninebark, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
WpB Whalan	Gray dogwood	Siberian crabapple, lilac, silky dogwood.	Eastern redcedar, Norway spruce.	Eastern wnite pine, red pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Wt----------------- Willette	---	Silky dogwood-----	Northern white-cedar.	---	Norway poplar.
WvB, WvC2--------- Wyocena Variant	---	Northern white-cedar, common ninebark, lilac, silky dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine.	---
ZuB, ZuC2--------- Zurich	---	Silky dogwood, lilac.	Autumn-olive, Amur maple, Russian-olive.	Eastern white pine, red pine, Norway spruce, white spruce.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ac------ Adrian	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: excess humus, floods.
As*. Aquents						
BcA------ Bellevue	Severe: floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.
BrB------ Boyer	Severe: cutbanks cave.	Slight------	Slight------	Moderate: slope.	Slight------	Slight.
BrC2------ Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
BsB------ Boyer	Severe: cutbanks cave.	Slight------	Slight------	Moderate: slope.	Slight------	Slight.
BtB------ Briggsville	Moderate: wetness.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Slight.
BtC2------ Briggsville	Moderate: slope.	Severe: low strength.	Severe: low strength.	Severe: low strength, slope.	Severe: low strength.	Moderate: slope.
Bu------ Brookston	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods.
CnB------ Channahon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
CnC------ Channahon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: thin layer.
CoA------ Cosad	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Severe: too sandy.
DoB------ Dodge	Slight------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength, frost action.	Slight.
Du*. Dune land						
Fu*. Fluvaquents						
Gb------ Granby	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
HmB------ Hochheim	Slight------	Slight------	Slight------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
HmC2------ Hochheim	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, frost action.	Moderate: slope.
HmD2------ Hochheim	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HnB*:						
Hochheim	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Nichols	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
Boyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
HnC2*:						
Hochheim	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, frost action.	Moderate: slope.
Nichols	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
HnD*:						
Hochheim	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Nichols	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
HrB Hortonville	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.	Slight.
HrC2 Hortonville	Moderate: slope.	Moderate: low strength, shrink-swell, slope.	Moderate: low strength, shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
HrD2 Hortonville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Hu Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, floods, low strength.	Severe: wetness, low strength, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: excess humus, wetness, floods.
Ke Keowns	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Severe: wetness, floods.
KnB Kewaunee	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Severe: low strength.	Slight.
KnC2 Kewaunee	Severe: too clayey.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, slope.	Severe: slope.	Severe: low strength.	Moderate: slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KnD2, KnE: Kewaunee	Severe: slope, too clayey.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
KpB*:						
Kewaunee	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Severe: low strength.	Slight.
Boyer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Nichols	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
KpC2*:						
Kewaunee	Severe: too clayey.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Boyer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Nichols	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
KpD*:						
Kewaunee	Severe: slope, too clayey.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Boyer	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Nichols	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
KrB: Kolberg	Severe: too clayey.	Moderate: low strength, shrink-swell.	Moderate: depth to rock, shrink-swell, low strength.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.	Moderate: thin layer.
KrC2: Kolberg	Severe: too clayey.	Moderate: low strength, shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
LmA: Lamartine	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, frost action.	Moderate: wetness, floods.
LuB: Lutzke	Severe: cutbanks cave, small stones.	Slight	Slight	Moderate: slope.	Slight	Slight.
LuC2: Lutzke	Severe: cutbanks cave, small stones.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
LuD: Lutzke	Severe: slope, cutbanks cave, small stones.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MbA: Manawa	Severe: wetness, too clayey, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: floods, low strength.	Moderate: wetness, floods.
McB*:						
Manawa	Severe: wetness, too clayey, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: floods, low strength.	Moderate: wetness, floods.
Kewaunee	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.	Slight.
Poygan	Severe: wetness, floods, too clayey.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods.
MlA: Mayville	Moderate: wetness.	Moderate: low strength, shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: frost action, low strength.	Slight.
MsA: Mosel	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action, low strength.	Moderate: wetness.
MuA: Mundelein	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
NsB: Nichols	Severe: cutbanks cave.	Slight	Moderate: wetness.	Moderate: slope.	Severe: frost action.	Slight.
NsC2: Nichols	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
OaB: Oakville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: too sandy.
OaC: Oakville	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
OgB*:						
Oakville	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: too sandy.
Granby	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
OzC2: Omro	Moderate: too clayey, slope.	Moderate: low strength, slope.	Moderate: low strength, slope.	Severe: slope, low strength.	Severe: low strength,	Moderate: slope.
Pa: Palms	Severe: wetness, excess humus, floods.	Severe: wetness, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, excess humus.
Pe: Pella	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Pg*, Ph*. Pits						
PlB----------------- Plainfield	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: too sandy.
PlC----------------- Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: too sandy, slope.
PlD----------------- Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Po------------------ Poygan	Severe: wetness, floods, too clayey.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods.
ShA----------------- Shiocton	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action, floods.	Moderate: wetness.
SyA----------------- Symco	Severe: wetness.	Severe: floods, wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action, low strength.	Moderate: wetness.
TeA----------------- Tedrow	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
ThB----------------- Theresa	Slight----------	Moderate: shrink-swell, low strength.	Slight----------	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.
TuB----------------- Tustin	Severe: too clayey.	Slight----------	Severe: low strength.	Severe: low strength.	Slight----------	Moderate: too sandy.
Ud*. Udorthents						
WaA----------------- Wasepi	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action.	Moderate: wetness.
We------------------ Wauseon	Severe: wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength, frost action.	Severe: wetness.
WoB----------------- Waymor	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.
WoC2---------------- Waymor	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: low strength.	Moderate: slope.
WoD2---------------- Waymor	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
WpB----------------- Whalan	Moderate: depth to rock.	Severe: shrink-swell, low strength.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.	Moderate: thin layer.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Wt----------------- Willette	Severe: wetness, excess humus, cutbanks cave.	Severe: wetness, excess humus, frost action.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength, frost action.	Severe: wetness, excess humus, floods.
WvB---------------- Wyocena Variant	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
WvC2--------------- Wyocena Variant	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
ZuB---------------- Zurich	Slight---------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Moderate: shrink-swell, slope, low strength.	Severe: frost action, low strength.	Slight.
ZuC2--------------- Zurich	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some of the terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ac-------------------- Adrian	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
As*. Aquents					
BcA------------------- Bellevue	Severe: floods.	Severe: floods.	Severe: wetness, floods.	Severe: wetness, floods.	Good.
BrB------------------- Boyer	Slight**---------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: small stones.
BrC2------------------ Boyer	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: slope, small stones.
BsB------------------- Boyer	Slight**---------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: thin layer.
BtB------------------- Briggsville	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
BtC2------------------ Briggsville	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Bu-------------------- Brookston	Severe: wetness, percs slowly, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
CnB------------------- Channahon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: thin layer.
CnC------------------- Channahon	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer.
CoA------------------- Cosad	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: too sandy, too clayey, thin layer.
DoB------------------- Dodge	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Fair: small stones.
Du*. Dune land					
Fu*. Fluvaquents					
Gb-------------------- Granby	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy.
HmB------------------- Hochheim	Moderate: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Fair: small stones.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HmC2: Hochheim	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope, small stones.
HmD2: Hochheim	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
HnB*:					
Hochheim	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: small stones.
Nichols	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Boyer	Slight**	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: small stones.
HnC2*:					
Hochheim	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope, small stones.
Nichols	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Boyer	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: slope, small stones.
HnD*:					
Hochheim	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Boyer	Severe:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: slope.
Nichols	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
HrB: Hortonville	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
HrC2: Hortonville	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
HrD2: Hortonville	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: too clayey, slope.
Hu: Houghton	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: hard to pack, wetness.
Ke: Keowns	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
KnB: Kewaunee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
KnC2: Kewaunee	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KnD2----------------- Kewaunee	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: too clayey, slope.
KnE------------------ Kewaunee	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
KpB*:					
Kewaunee-----------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
Boyer--------------	Slight**---------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: small stones.
Nichols------------	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
KpC2*:					
Kewaunee-----------	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
Boyer--------------	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: slope, small stones.
Nichols------------	Moderate: slope.	Severe: slope.	Slight-----------	Moderate: slope.	Fair: slope.
KpD*:					
Kewaunee-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Severe: slope.	Poor: too clayey, slope.
Boyer--------------	Severe:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: slope.
Nichols------------	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
KrB------------------ Kolberg	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight-----------	Poor: thin layer, area reclaim.
KrC2----------------- Kolberg	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: thin layer, area reclaim.
LmA------------------ Lamartine	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: small stones.
LuB------------------ Lutzke	Slight**---------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones.
LuC2----------------- Lutzke	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones.
LuD------------------ Lutzke	Severe:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: small stones, slope.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MbA: Manawa	Severe: wetness, percs slowly, floods.	Slight	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
McB*:					
Manawa	Severe: wetness, percs slowly, floods.	Moderate: slope.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Kewaunee	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Poygan	Severe: wetness, percs slowly, floods.	Severe: floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
MlA: Mayville	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: small stones.
MsA: Mosel	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness, floods.	Fair: thin layer.
MuA: Mundelein	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
NsB: Nichols	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
NsC2: Nichols	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
OaB: Oakville	Slight**	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
OaC: Oakville	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
OgB*:					
Oakville	Slight**	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Granby	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy.
OzC2: Omro	Severe: percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: small stones, slope.
Pa: Palms	Severe: wetness, floods, subsides.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, seepage.	Poor: excess humus, wetness.
Pe: Pella	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Pg*, Ph*. Pits					
PlB: Plainfield	Slight**	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
PlC: Plainfield	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
PlD: Plainfield	Severe:** slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope.
Po: Poygan	Severe: wetness, percs slowly, floods.	Severe: floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
ShA: Shiocton	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Good.
SyA: Symco	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: thin layer.
TeA: Tedrow	Severe: wetness.	Severe: wetness, seepage.	Severe: too sandy, seepage, wetness.	Severe: seepage, wetness.	Poor: too sandy, wetness.
ThB: Theresa	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Fair: small stones.
TuB: Tustin	Severe: percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: hard to pack.
Ud*. Udorthents					
WaA: Wasepi	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: thin layer.
We: Wauseon	Severe: percs slowly, wetness.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
WoB: Waymor	Slight	Moderate: slope, seepage.	Slight	Slight	Fair: small stones.
WoC2: Waymor	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope, small stones.
WoD2: Waymor	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
WpB: Whalan	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: area reclaim.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Wt------------------ Willette	Severe: wetness, floods.	Severe: wetness, excess humus, seepage.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: excess humus, hard to pack.
WvB----------------- Wyocena Variant	Slight**----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
WvC2---------------- Wyocena Variant	Moderate:** slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
ZuB----------------- Zurich	Slight-----------	Severe: seepage.	Severe: seepage, wetness.	Slight-----------	Good.
ZuC2---------------- Zurich	Moderate: slope.	Severe: slope, seepage.	Severe: seepage, wetness.	Moderate: slope.	Fair: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.
** Rapid or very rapid permeability may cause pollution of ground water.

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ac-------------------- Adrian	Poor: excess humus, wetness.	Unsuited: excess humus.	Unsuited: excess fines, excess humus.	Poor: wetness, excess humus.
As*. Aquents				
BcA------------------- Bellevue	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
BrB------------------- Boyer	Good	Good	Good	Good.
BrC2------------------ Boyer	Good	Good	Good	Fair: slope.
BsB------------------- Boyer	Fair: low strength.	Poor: thin layer.	Poor: thin layer.	Fair: thin layer.
BtB------------------- Briggsville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
BtC2------------------ Briggsville	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Bu-------------------- Brookston	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
CnB, CnC-------------- Channahon	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
CoA------------------- Cosad	Fair: wetness, low strength.	Poor: thin layer.	Unsuited	Poor: too sandy.
DoB------------------- Dodge	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Du*. Dune land				
Fu*. Fluvaquents				
Gb-------------------- Granby	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
HmB, HmC2------------- Hochheim	Fair: low strength.	Unsuited: excess fines.	Poor: excess fines.	Poor: thin layer.
HmD2------------------ Hochheim	Fair: low strength, slope.	Unsuited: excess fines.	Poor: excess fines.	Poor: slope.
HnB*:				
Hochheim-------------	Fair: low strength.	Unsuited: excess fines.	Poor: excess fines.	Poor: thin layer.
Nichols--------------	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Boyer----------------	Good	Good	Good	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
HnC2*:				
Hochheim	Fair: low strength.	Unsuited: excess fines.	Poor: excess fines.	Poor: thin layer.
Nichols	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Boyer	Good	Good	Good	Fair: slope.
HnD*:				
Hochheim	Fair: low strength, slope.	Unsuited: excess fines.	Poor: excess fines.	Poor: slope.
Boyer	Fair: slope.	Good	Good	Poor: slope.
Nichols	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
HrB Hortonville	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
HrC2 Hortonville	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
HrD2 Hortonville	Fair: low strength, shrink-swell, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Hu Houghton	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Ke Keowns	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
KnB Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
KnC2 Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
KnD2 Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
KnE Kewaunee	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
KpB*:				
Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Boyer	Good	Good	Good	Good.
Nichols	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
KpC2*:				
Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Boyer	Good	Good	Good	Fair: slope.
Nichols	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
KpD*:				
Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Boyer	Fair: slope.	Good	Good	Poor: slope.
Nichols	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
KrB Kolberg	Poor: low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
KrC2 Kolberg	Poor: low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
LmA Lamartine	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
LuB, LuC2 Lutzke	Good	Good	Good	Poor: small stones.
LuD Lutzke	Fair: slope.	Good	Good	Poor: small stones, slope.
MbA Manawa	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
McB*:				
Manawa	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Kewaunee	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Poygan	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
MlA Mayville	Good	Poor: excess fines.	Poor: excess fines.	Fair: thin layer.
MsA Mosel	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
MuA Mundelein	Poor: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
NsB Nichols	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
NsC2 Nichols	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OaB: Oakville	Good	Good	Unsuited: excess fines.	Fair: too sandy, thin layer.
OaC: Oakville	Good	Good	Unsuited: excess fines.	Fair: too sandy, thin layer, slope.
OgB*:				
Oakville	Good	Good	Unsuited: excess fines.	Fair: too sandy, thin layer.
Granby	Poor: wetness.	Good	Unsuited: excess fines.	Poor: wetness.
OzC2: Omro	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.
Pa: Palms	Poor: wetness, low strength.	Unsuited: excess humus.	Unsuited: excess humus.	Poor: wetness, excess humus.
Pe: Pella	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Pg*, Ph*. Pits				
PlB: Plainfield	Good	Good	Unsuited: excess fines.	Fair: too sandy.
PlC: Plainfield	Good	Good	Unsuited: excess fines.	Fair: too sandy, slope.
PlD: Plainfield	Fair: slope.	Good	Unsuited: excess fines.	Poor: slope.
Po: Poygan	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
ShA: Shiocton	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
SyA: Symco	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
TeA: Tedrow	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
ThB: Theresa	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
TuB: Tustin	Poor: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Ud*. Udorthents				
WaA: Wasepi	Good	Good	Good	Fair: thin layer.
We: Wauseon	Poor: wetness, low strength, shrink-swell.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
WoB------------------- Waymor	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
WoC2------------------ Waymor	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
WoD2------------------ Waymor	Fair: shrink-swell, low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
WpB------------------- Whalan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
Wt-------------------- Willette	Poor: excess humus, wetness.	Unsuited: excess fines, excess humus.	Unsuited: excess fines, excess humus.	Poor: wetness.
WvB------------------- Wyocena Variant	Good------------------	Poor: excess fines.	Unsuited: excess fines.	Good.
WvC2------------------ Wyocena Variant	Good------------------	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
ZuB------------------- Zurich	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
ZuC2------------------ Zurich	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
Ac----------------- Adrian	Seepage--------	Seepage, wetness.	Favorable------	Floods, frost action.	Not needed-----	Wetness.
As*. Aquents						
BcA---------------- Bellevue	Seepage--------	Piping---------	Deep to water, slow refill.	Floods---------	Not needed-----	Favorable.
BrB---------------- Boyer	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Droughty.
BrC2--------------- Boyer	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Slope, droughty.
BsB---------------- Boyer	Seepage--------	Seepage--------	No water-------	Not needed-----	Too sandy, soil blowing.	Droughty.
BtB---------------- Briggsville	Favorable------	Hard to pack---	Deep to water, slow refill.	Not needed-----	Favorable------	Erodes easily.
BtC2--------------- Briggsville	Favorable------	Hard to pack---	No water-------	Not needed-----	Favorable------	Slope, erodes easily.
Bu----------------- Brookston	Favorable------	Wetness--------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
CnB---------------- Channahon	Depth to rock	Thin layer-----	No water-------	Not needed-----	Depth to rock	Erodes easily, droughty, rooting depth.
CnC---------------- Channahon	Depth to rock	Thin layer-----	No water-------	Not needed-----	Depth to rock	Slope, erodes easily, droughty.
CoA---------------- Cosad	Seepage--------	Piping, low strength.	Cutbanks cave	Percs slowly---	Not needed-----	Wetness, erodes easily.
DoB---------------- Dodge	Seepage--------	Piping---------	No water-------	Not needed-----	Favorable------	Erodes easily.
Du*. Dune land						
Fu*. Fluvaquents						
Gb----------------- Granby	Seepage--------	Seepage, wetness.	Favorable------	Cutbanks cave, floods.	Not needed-----	Wetness.
HmB---------------- Hochheim	Seepage--------	Favorable------	No water-------	Not needed-----	Complex slope	Favorable.
HmC2--------------- Hochheim	Slope, seepage.	Favorable------	No water-------	Not needed-----	Complex slope	Slope.
HmD2--------------- Hochheim	Slope, seepage.	Favorable------	No water-------	Not needed-----	Slope----------	Slope.
HnB*: Hochheim----------	Seepage--------	Favorable------	No water-------	Not needed-----	Complex slope	Favorable.
Nichols-----------	Seepage--------	Piping---------	No water-------	Not needed-----	Piping---------	Erodes easily.
Boyer-------------	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Droughty.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
HnC2*:						
Hochheim----------	Slope, seepage.	Favorable------	No water-------	Not needed-----	Complex slope	Slope.
Nichols----------	Seepage--------	Piping---------	No water-------	Not needed-----	Piping---------	Erodes easily, slope.
Boyer------------	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Slope, droughty.
HnD*:						
Hochheim---------	Slope, seepage.	Favorable------	No water-------	Not needed-----	Slope----------	Slope.
Boyer------------	Seepage--------	Seepage--------	No water-------	Not needed-----	Slope, soil blowing, too sandy.	Slope, droughty.
Nichols----------	Seepage, slope.	Piping---------	No water-------	Not needed-----	Piping, slope.	Erodes easily, slope.
HrB--------------- Hortonville	Seepage, slope.	Low strength, shrink-swell.	No water-------	Not needed-----	Complex slope	Erodes easily.
HrC2-------------- Hortonville	Seepage, slope.	Low strength, shrink-swell.	No water-------	Not needed-----	Complex slope	Slope, erodes easily.
HrD2-------------- Hortonville	Seepage, slope.	Low strength, shrink-swell.	No water-------	Not needed-----	Slope----------	Slope, erodes easily.
Hu---------------- Houghton	Seepage--------	Excess humus, low strength.	Favorable------	Poor outlets, frost action.	Not needed-----	Wetness.
Ke---------------- Keowns	Seepage--------	Wetness--------	Favorable------	Floods, frost action.	Not needed-----	Wetness.
KnB--------------- Kewaunee	Favorable------	Hard to pack---	No water-------	Not needed-----	Percs slowly---	Erodes easily, percs slowly.
KnC2-------------- Kewaunee	Favorable------	Hard to pack---	No water-------	Not needed-----	Percs slowly---	Slope, erodes easily, percs slowly.
KnD2, KnE--------- Kewaunee	Favorable------	Hard to pack---	No water-------	Not needed-----	Slope, percs slowly.	Slope, erodes easily, percs slowly.
KpB*:						
Kewaunee---------	Favorable------	Hard to pack---	No water-------	Not needed-----	Percs slowly---	Erodes easily, percs slowly.
Boyer------------	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Droughty.
Nichols----------	Seepage--------	Piping---------	No water-------	Not needed-----	Piping---------	Erodes easily.
KpC2*:						
Kewaunee---------	Favorable------	Hard to pack---	No water-------	Not needed-----	Percs slowly---	Slope, erodes easily, percs slowly.
Boyer------------	Seepage--------	Seepage--------	No water-------	Not needed-----	Complex slope, soil blowing, too sandy.	Slope, droughty.
Nichols----------	Seepage--------	Piping---------	No water-------	Not needed-----	Piping---------	Erodes easily, slope.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
KpD*:						
Kewaunee	Favorable	Hard to pack	No water	Not needed	Slope, percs slowly.	Slope, erodes easily, percs slowly.
Boyer	Seepage	Seepage	No water	Not needed	Slope, soil blowing, too sandy.	Slope, droughty.
Nichols	Seepage, slope.	Piping	No water	Not needed	Piping, slope.	Erodes easily, slope.
KrB Kolberg	Depth to rock	Thin layer	No water	Not needed	Erodes easily, percs slowly.	Erodes easily, percs slowly, depth to rock.
KrC2 Kolberg	Depth to rock	Thin layer	No water	Not needed	Erodes easily, percs slowly.	Slope, erodes easily, depth to rock.
LmA Lamartine	Seepage	Favorable	Favorable	Frost action, floods.	Not needed	Wetness.
LuB Lutzke	Seepage	Seepage	No water	Not needed	Complex slope, too sandy, soil blowing.	Droughty.
LuC2 Lutzke	Seepage	Seepage	No water	Not needed	Complex slope, too sandy, soil blowing.	Slope, droughty.
LuD Lutzke	Seepage	Seepage	No water	Not needed	Slope, too sandy, soil blowing.	Slope, droughty.
MbA Manawa	Favorable	Hard to pack, wetness.	Slow refill	Percs slowly, floods, frost action.	Not needed	Wetness, percs slowly, erodes easily.
McB*:						
Manawa	Favorable	Hard to pack, wetness.	Slow refill	Percs slowly, floods, frost action.	Wetness, percs slowly.	Wetness, percs slowly, erodes easily.
Kewaunee	Favorable	Hard to pack	No water	Not needed	Percs slowly	Erodes easily, percs slowly.
Poygan	Favorable	Hard to pack, wetness.	Slow refill	Percs slowly, floods, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
MlA Mayville	Seepage	Favorable	Deep to water, slow refill.	Not needed	Favorable	Erodes easily.
MsA Mosel	Favorable	Favorable	Slow refill	Frost action	Not needed	Wetness.
MuA Mundelein	Seepage	Piping	Slow refill	Frost action	Not needed	Wetness.
NsB Nichols	Seepage	Piping	Deep to water, slow refill.	Not needed	Piping	Erodes easily.
NsC2 Nichols	Seepage	Piping	No water	Not needed	Piping	Erodes easily, slope.
OaB Oakville	Seepage	Piping, seepage.	No water	Not needed	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
OaC: Oakville	Seepage	Piping, seepage.	No water	Not needed	Too sandy, soil blowing.	Droughty, slope.
OgB*:						
Oakville	Seepage	Piping, seepage.	Deep to water	Not needed	Too sandy, soil blowing.	Droughty.
Granby	Seepage	Seepage, wetness.	Favorable	Cutbanks cave, floods.	Not needed	Wetness.
OzC2: Omro	Seepage	Piping	Deep to water, slow refill.	Not needed	Erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Pa: Palms	Seepage	Excess humus, wetness.	Favorable	Floods, frost action.	Not needed	Wetness.
Pe: Pella	Seepage	Wetness	Slow refill	Floods, frost action.	Not needed	Wetness.
Pg*, Ph*. Pits						
PlB: Plainfield	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Droughty.
PlC: Plainfield	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Droughty, slope.
PlD: Plainfield	Seepage	Seepage	No water	Not needed	Slope, too sandy, soil blowing.	Droughty, slope.
Po: Poygan	Favorable	Hard to pack, wetness.	Slow refill	Percs slowly, floods, frost action.	Not needed	Wetness, percs slowly.
ShA: Shiocton	Seepage	Piping, wetness.	Slow refill	Floods, frost action.	Not needed	Wetness.
SyA: Symco	Favorable	Wetness	Slow refill	Frost action	Not needed	Favorable.
TeA: Tedrow	Seepage	Piping, seepage, wetness.	Favorable	Cutbanks cave	Not needed	Wetness, droughty.
ThB: Theresa	Seepage	Favorable	No water	Not needed	Favorable	Favorable.
TuB: Tustin	Seepage	Hard to pack	No water	Not needed	Too sandy, soil blowing.	Favorable.
Ud*. Udorthents						
WaA: Wasepi	Seepage	Seepage, wetness.	Favorable	Cutbanks cave, wetness, frost action.	Not needed	Droughty, wetness.
We: Wauseon	Seepage	Wetness	Slow intake	Percs slowly	Not needed	Wetness, percs slowly.
WoB: Waymor	Seepage	Favorable	No water	Not needed	Favorable	Erodes easily.
WoC2: Waymor	Seepage	Favorable	No water	Not needed	Favorable	Erodes easily, slope.
WoD2: Waymor	Seepage, slope.	Favorable	No water	Not needed	Slope	Erodes easily, slope.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
WpB: Whalan	Depth to rock	Thin layer, hard to pack.	No water	Not needed	Depth to rock	Depth to rock.
Wt: Willette	Seepage	Compressible, hard to pack, low strength.	Favorable	Wetness, cutbanks cave, poor outlets.	Not needed	Not needed.
WvB: Wyocena Variant	Seepage	Piping, seepage.	No water	Not needed	Too sandy, soil blowing.	Droughty.
WvC2: Wyocena Variant	Seepage	Piping, seepage.	No water	Not needed	Too sandy, soil blowing.	Slope, droughty.
ZuB: Zurich	Seepage	Piping	No water	Not needed	Favorable	Erodes easily.
ZuC2: Zurich	Seepage	Piping	No water	Not needed	Favorable	Slope, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ac Adrian	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, floods.
As*. Aquents					
BcA Bellevue	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
BrB Boyer	Slight	Slight	Moderate: slope.	Slight	Slight.
BrC2 Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
BsB Boyer	Slight	Slight	Moderate: slope.	Slight	Slight.
BtB Briggsville	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight	Slight.
BtC2 Briggsville	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Bu Brookston	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
CnB Channahon	Slight	Slight	Severe: depth to rock.	Slight	Severe: thin layer.
CnC Channahon	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight	Severe: thin layer.
CoA Cosad	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Severe: too sandy.
DoB Dodge	Slight	Slight	Moderate: slope.	Slight	Slight.
Du*. Dune land					
Fu*. Fluvaquents					
Gb Granby	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
HmB Hochheim	Slight	Slight	Moderate: slope.	Slight	Slight.
HmC2 Hochheim	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
HmD2 Hochheim	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HnB*:					
Hochheim	Slight	Slight	Moderate: slope.	Slight	Slight.
Nichols	Slight	Slight	Moderate: slope.	Slight	Slight.
Boyer	Slight	Slight	Moderate: slope.	Slight	Slight.
HnC2*:					
Hochheim	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Nichols	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
HnD*:					
Hochheim	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Nichols	Severe: slope.	Severe: slope.	Severe: slope.	Moderate	Severe: slope.
HrB Hortonville	Slight	Slight	Moderate: slope.	Slight	Slight.
HrC2 Hortonville	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
HrD2 Hortonville	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Hu Houghton	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.
Ke Keowns	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
KnB Kewaunee	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight	Slight.
KnC2 Kewaunee	Moderate: percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
KnD2 Kewaunee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
KnE Kewaunee	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
KpB*:					
Kewaunee	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
KpB*:					
Boyer	Slight	Slight	Moderate: slope.	Slight	Slight.
Nichols	Slight	Slight	Moderate: slope.	Slight	Slight.
KpC2*:					
Kewaunee	Moderate: percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Boyer	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Nichols	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
KpD*:					
Kewaunee	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Boyer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Nichols	Severe: slope.	Severe: slope.	Severe: slope.	Moderate	Severe: slope.
KrB Kolberg	Moderate: percs slowly.	Slight	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: thin layer.
KrC2 Kolberg	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope, thin layer.
LmA Lamartine	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
LuB Lutzke	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
LuC2 Lutzke	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
LuD Lutzke	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
MbA Manawa	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
McB*:					
Manawa	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
Kewaunee	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight	Slight.
Poygan	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MlA-------------------- Mayville	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
MsA-------------------- Mosel	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
MuA-------------------- Mundelein	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
NsB-------------------- Nichols	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
NsC2------------------- Nichols	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
OaB-------------------- Oakville	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Moderate: too sandy.
OaC-------------------- Oakville	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
OgB*------------------- Oakville.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Moderate: too sandy.
Granby----------------	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
OzC2------------------- Omro	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Pa--------------------- Palms	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, excess humus.	Severe: wetness, floods, excess humus.
Pe--------------------- Pella	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Pg*, Ph*. Pits					
PlB-------------------- Plainfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Moderate: too sandy.
PlC-------------------- Plainfield	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
PlD-------------------- Plainfield	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, too sandy.	Severe: slope.
Po--------------------- Poygan	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
ShA-------------------- Shiocton	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
SyA-------------------- Symco	Severe: floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
TeA: Tedrow	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: too sandy, wetness.	Severe: wetness.
ThB: Theresa	Slight	Slight	Moderate: slope.	Slight	Slight.
TuB: Tustin	Moderate: percs slowly, too sandy.	Moderate: too sandy.	Moderate: slope, too sandy, percs slowly.	Moderate: too sandy.	Moderate: too sandy.
Ud*. Udorthents					
WaA: Wasepi	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
We: Wauseon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
WoB: Waymor	Slight	Slight	Moderate: slope.	Slight	Slight.
WoC2: Waymor	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
WoD2: Waymor	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
WpB: Whalan	Slight	Slight	Moderate: depth to rock, slope, percs slowly.	Slight	Moderate: thin layer.
Wt: Willette	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.	Severe: wetness, floods, excess humus.
WvB: Wyocena Variant	Slight	Slight	Moderate: slope.	Slight	Slight.
WvC2: Wyocena Variant	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
ZuB: Zurich	Slight	Slight	Moderate: slope.	Slight	Slight.
ZuC2: Zurich	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ac*:										
Adrian, undrained	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Adrian, drained---	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
As*. Aquents										
BcA----------------- Bellevue	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Very poor.
BrB----------------- Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BrC2---------------- Boyer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
BsB----------------- Boyer	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
BtB----------------- Briggsville	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
BtC2---------------- Briggsville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Bu*:										
Brookston, undrained---------	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Brookston, drained	Fair	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor.
CnB, CnC------------ Channahon	Poor	Poor	Fair	Fair	Fair	Poor	Very poor.	Poor	Fair	Very poor.
CoA----------------- Cosad	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
DoB----------------- Dodge	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Du*. Dune land										
Fu*. Fluvaquents										
Gb*:										
Granby, undrained-	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Granby, drained---	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair	Poor	Poor.
HmB----------------- Hochheim	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
HmC2---------------- Hochheim	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
HmD2---------------- Hochheim	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
HnB*:										
Hochheim	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
Nichols	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HnC2*:										
Hochheim	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
Nichols	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Boyer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
HnD*:										
Hochheim	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Boyer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Nichols	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
HrB Hortonville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HrC2 Hortonville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
HrD2 Hortonville	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hu*:										
Houghton, undrained	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Houghton, drained	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
Ke*:										
Keowns, undrained	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Keowns, drained	Good	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor.
KnB Kewaunee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
KnC2 Kewaunee	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
KnD2 Kewaunee	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KnE Kewaunee	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KpB*:										
Kewaunee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
KpB*:										
Boyer	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Nichols	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
KpC2*:										
Kewaunee	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Boyer	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Nichols	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
KpD*:										
Kewaunee	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Boyer	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Nichols	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
KrB, KrC2 Kolberg	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
LmA Lamartine	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
LuB, LuC2 Lutzke	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
LuD Lutzke	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
MbA Manawa	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
McB*:										
Manawa	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Kewaunee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Poygan, drained	Fair	Fair	Fair	Good	Good	Fair	Poor	Fair	Good	Poor.
MlA Mayville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MsA Mosel	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MuA Mundelein	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
NsB Nichols	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
NsC2 Nichols	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
OaB---------------- Oakville	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
OaC---------------- Oakville	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
OgB*--------------- Oakville	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Granby, undrained-	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
OzC2--------------- Omro	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pa*:										
Palms, undrained--	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Poor	Good.
Palms, drained----	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
Pe*:										
Pella, undrained--	Poor	Poor	Good	Fair	Poor	Good	Good	Poor	Fair	Good.
Pella, drained----	Good	Good	Good	Fair	Poor	Fair	Fair	Good	Fair	Fair.
Pg*, Ph*. Pits										
PlB, PlC, PlD------ Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Po*:										
Poygan, undrained	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Poygan, drained---	Good	Fair	Fair	Good	Good	Fair	Poor	Fair	Good	Poor.
ShA---------------- Shiocton	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
SyA---------------- Symco	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
TeA---------------- Tedrow	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
ThB---------------- Theresa	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
TuB---------------- Tustin	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Ud*. Udorthents										
WaA---------------- Wasepi	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
We*:										
Wauseon, undrained	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Wauseon, drained--	Fair	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor.
WoB---------------- Waymor	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WoC2--------------- Waymor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
WoD2--------------- Waymor	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
WpB-----------------Whalan	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Wt*:										
Willette, undrained---------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Willette, drained	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
WvB, WvC2-----------Wyocena Variant	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
ZuB, ZuC2-----------Zurich	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ac------------------ Adrian	0-40	Sapric material	Pt	---	---	---	---	---	---	---	---
	40-60	Sand, loamy sand	SP, SM	A-2, A-3	0	100	90-100	50-75	0-20	---	NP
As*. Aquents											
BcA---------------- Bellevue	0-11	Silt loam--------	ML, CL-ML	A-4	0	100	100	85-100	60-90	20-30	1-7
	11-35	Loam, sandy loam, sandy clay loam.	SC, SM-SC, CL, CL-ML	A-4, A-6, A-2-4, A-2-6	0	100	100	60-95	30-75	20-30	5-15
	35-60	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	20-40	5-20
BrB, BrC2---------- Boyer	0-9	Sandy loam-------	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	9-29	Sandy loam, gravelly sandy loam, gravelly sandy clay loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	29-60	Stratified sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
BsB---------------- Boyer	0-10	Sandy loam-------	SM	A-2, A-4	0-5	85-100	85-95	60-75	25-40	10-19	1-4
	10-27	Gravelly loam, gravelly sandy loam, sandy clay loam.	CL, ML, SC, SM	A-2, A-4, A-6	0-5	60-85	55-80	45-70	25-55	15-35	2-16
	27-48	Sand and gravel	SP, SP-SM, GP, GP-GM	A-1, A-3	0-10	40-70	35-70	30-60	0-10	---	NP
	48-60	Stratified very fine sand to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	65-85	10-25	1-16
BtB, BtC2---------- Briggsville	0-10	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	60-90	30-40	5-15
	10-31	Silty clay, silty clay loam.	CH, CL	A-6, A-7	0	100	100	95-100	95-100	30-65	15-40
	31-60	Silty clay loam silt loam, fine sandy loam.	CL, CH, ML	A-4, A-6 A-7	0	100	100	95-100	90-100	30-60	NP-35
Bu----------------- Brookston	0-12	Silt loam--------	CL	A-4, A-6	0	98-100	98-100	85-100	60-90	22-40	8-18
	12-19	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	98-100	85-100	75-95	60-85	36-52	18-30
	19-60	Loam, sandy loam, clay loam.	CL	A-4, A-6	0-3	90-100	85-95	78-90	55-70	22-30	7-15
CnB, CnC----------- Channahon	0-8	Loam-------------	CL	A-6, A-4	0-20	95-100	95-100	85-100	65-90	21-38	7-18
	8-18	Loam, sandy clay loam, clay loam	CL	A-6, A-7	0-20	95-100	90-100	85-100	50-85	30-46	15-25
	18-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
CoA----------------- Cosad	0-9	Loamy fine sand	SM	A-2, A-4	0	100	90-100	65-85	20-40	---	NP
	9-26	Loamy fine sand, fine sand.	SM	A-2, A-4	0	100	90-100	60-80	15-40	---	NP
	26-60	Silty clay, clay, silty clay loam.	CL, ML	A-7, A-4, A-6	0	100	90-100	90-100	75-95	20-45	5-25
DoB----------------- Dodge	0-8	Silt loam-------	CL, CL-ML, ML	A-4	0	100	100	90-100	70-95	20-30	3-10
	8-31	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	35-55	15-25
	31-37	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0-2	90-100	85-95	75-95	45-60	30-45	15-25
	37-60	Loam, gravelly sandy loam, gravelly loam.	ML, CL, SM, SC	A-2, A-4	1-5	75-90	65-90	60-80	15-70	15-30	NP-10
Du*. Dune land											
Fu*. Fluvaquents											
Gb------------------ Granby	0-12	Fine sandy loam	SM	A-2	0	100	100	60-70	20-35	---	NP
	12-60	Sand------------	SP, SP-SM	A-3, A-2-4	0	100	95-100	50-70	0-5	---	NP
HmB, HmC2, HmD2---- Hochheim	0-11	Loam------------	ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-30	3-10
	11-21	Clay loam-------	CL, CH	A-6, A-7	0-2	85-95	70-85	60-70	55-65	35-55	15-35
	21-60	Gravelly loam, gravelly sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-10	50-95	50-90	30-80	15-75	<20	NP-6
HnB*, HnC2*: Hochheim----------	0-11	Loam------------	ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-30	3-10
	11-21	Clay loam-------	CL, CH	A-6, A-7	0-2	85-95	70-85	60-70	55-65	35-55	15-35
	21-60	Gravelly loam, gravelly sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-10	50-95	50-90	30-80	15-75	<20	NP-6
Nichols-----------	0-23	Very fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-95	45-60	<20	2-6
	23-60	Stratified very fine sand to silt.	ML, CL-ML	A-4	0	100	95-100	85-100	75-100	<20	NP-6
Boyer-------------	0-9	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	9-29	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	29-60	Stratified sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
HnD*:											
Hochheim----------	0-11	Loam------------	ML, CL,	A-4	0	100	100	85-100	60-90	20-30	3-10
	11-21	Clay loam-------	CL, CH	A-6, A-7	0-2	85-95	70-85	60-70	55-65	35-55	15-35
	21-60	Gravelly loam, gravelly sandy loam, loam.	SM, SM-SC, ML,	A-2, A-4	0-10	50-95	50-90	30-80	15-75	<20	NP-6
Boyer-------------	0-9	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	9-29	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	29-60	Stratified sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Nichols-----------	0-23	Very fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-95	45-60	<20	2-6
	23-60	Stratified very fine sand to silt.	ML, CL-ML	A-4	0	100	95-100	85-100	75-100	<20	NP-6
HrB, HrC2, HrD2---- Hortonville	0-7	Silt loam-------	ML, CL	A-4	0-5	95-100	95-100	85-100	60-90	20-30	3-10
	7-25	Silty clay loam, clay loam, loam.	CL, CH	A-7, A-6	0-5	85-100	85-100	80-100	70-85	35-60	20-37
	25-60	Silty clay loam, clay loam, loam.	CL, SC	A-4, A-6	0-10	75-100	75-95	60-90	45-80	24-30	8-14
Hu---------------- Houghton	0-60	Sapric material	PT	---	0	---	---	---	---	---	---
Ke---------------- Keowns	0-13	Very fine sandy loam.	ML, SM	A-4	0	100	100	65-95	35-65	<20	NP-4
	13-29	Silt loam, very fine sandy loam, sandy loam.	ML, CL, SM, SC	A-4, A-2	0	100	100	60-100	30-85	<20	NP-10
	29-60	Stratified sandy loam to fine sand.	ML, SM	A-2, A-4	0	100	100	70-95	30-95	<20	NP-4
KnB, KnC2, KnD2, KnE--------------- Kewaunee	0-8	Loam------------	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	50-70	20-30	2-10
	8-23	Clay, silty clay, clay loam.	CL, CH	A-7	0	90-100	90-100	90-100	75-95	45-70	30-45
	23-60	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	90-100	90-100	90-100	65-95	30-60	15-35
KpB*, KpC2*, KpD*:											
Kewaunee----------	0-8	Loam------------	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	50-70	20-30	2-10
	8-23	Clay, silty clay, clay loam.	CL, CH	A-7	0	90-100	90-100	90-100	75-95	45-70	30-45
	23-60	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	90-100	90-100	90-100	65-95	30-60	15-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
KpB*, KpC2*, KpD*:											
Boyer	0-9	Sandy loam	SM, SM-SC	A-2, A-4	0-5	95-100	65-95	60-75	25-40	<25	NP-7
	9-29	Sandy loam, loam, gravelly sandy loam.	SM, SC, SM-SC, SP-SM	A-2, A-4, A-6	0-5	80-100	65-95	55-85	10-45	10-35	NP-16
	29-60	Stratified sand and gravel.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2-4	0-10	40-100	35-100	30-70	0-10	---	NP
Nichols	0-23	Very fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-95	45-60	<20	2-6
	23-60	Stratified very fine sand to silt.	ML, CL-ML	A-4	0	100	95-100	85-100	75-100	<20	NP-6
KrB, KrC2 Kolberg	0-8	Loam	ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-30	3-10
	8-26	Clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	95-100	95-100	90-100	75-95	35-65	20-35
	26-29	Loam, clay loam, gravelly clay loam.	CL, CL-ML	A-4, A-6	0	80-100	80-100	75-90	65-75	20-35	5-15
	29-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
LmA Lamartine	0-10	Silt loam	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	3-10
	10-27	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-50	15-30
	27-32	Clay loam, loam	CL	A-6	0	85-100	85-100	85-95	60-80	25-40	10-25
	32-60	Loam, sandy loam, gravelly sandy loam.	CL, ML, SM, SC	A-4, A-6	0	75-90	65-90	60-80	35-70	20-30	NP-10
LuB, LuC2, LuD Lutzke	0-6	Sandy loam	SM	A-2, A-4	0-10	70-100	70-100	60-70	30-40	<20	NP-4
	6-19	Gravelly clay loam, gravelly loam, gravelly sandy loam.	GM, GP-GM, GM-GC	A-1, A-2, A-4	0-10	30-55	30-55	25-50	10-40	<25	NP-7
	19-24	Gravelly loam, gravelly sandy clay loam, gravelly sandy loam.	GM, GP-GM, GM-GC	A-1, A-2	0-10	30-55	30-55	20-50	10-35	<25	NP-7
	24-60	Very gravelly sand, gravelly sand, cobbly sand.	GP, GP-GM	A-1	0-10	5-45	5-45	5-15	2-6	---	NP
MbA Manawa	0-7	Silt loam	ML, CL	A-4, A-6	0	100	100	85-100	60-90	30-40	6-15
	7-22	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	90-100	90-100	90-100	65-95	45-70	30-45
	22-60	Silty clay, silty clay loam, clay.	CH, CL	A-6, A-7	0-5	90-100	90-100	90-100	65-95	30-60	15-35
McB*:											
Manawa	0-7	Silt loam	ML, CL	A-4, A-6	0	100	100	85-100	60-90	30-40	6-15
	7-22	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	90-100	90-100	90-100	65-95	45-70	30-45
	22-60	Silty clay, silty clay loam, clay.	CH, CL	A-6, A-7	0-5	90-100	90-100	90-100	65-95	30-60	15-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
McB*:											
Kewaunee	0-8	Loam	ML, CL, CL-ML	A-4	0	95-100	95-100	85-100	50-70	20-30	2-10
	8-23	Clay, silty clay, clay loam.	CL, CH	A-7	0	90-100	90-100	90-100	75-95	45-70	30-45
	23-60	Clay, silty clay, silty clay loam.	CL, CH	A-6, A-7	0	90-100	90-100	90-100	65-95	30-60	15-35
Poygan	0-10	Silty clay loam	CL, CH	A-7	0	100	100	90-100	75-95	45-55	25-35
	10-19	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	90-100	90-100	90-100	75-95	45-70	30-45
	19-60	Clay, silty clay	CL, CH	A-7, A-6	0-5	90-100	90-100	90-100	80-100	30-55	20-45
MlA: Mayville	0-8	Silt loam	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	3-10
	8-28	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	80-100	70-95	35-55	15-30
	28-34	Silty clay loam, clay loam.	CL	A-6, A-7	0-2	90-100	85-95	75-95	70-85	30-45	15-25
	34-60	Gravelly sandy loam, loam, gravelly loam.	SM, SC, ML, CL	A-2, A-4	0-5	75-90	65-90	60-80	15-70	15-30	NP-10
MsA: Mosel	0-12	Loam	ML, CL-ML	A-4	0	95-100	95-100	85-100	50-70	20-30	NP-5
	12-24	Loam, sandy loam, sandy clay loam.	SM-SC, SC, CL, CL-ML	A-4, A-6	0	90-100	90-100	45-70	40-65	20-40	5-25
	24-35	Silty clay loam, silty clay, clay.	CL	A-7	0	95-100	80-100	80-100	80-95	40-50	20-30
	35-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	95-100	80-100	80-100	80-95	25-50	10-30
MuA: Mundelein	0-9	Silt loam	ML, CL, OL	A-4, A-6	0	95-100	95-100	95-100	85-95	30-50	5-20
	9-26	Silty clay loam	CL	A-7, A-6	0	95-100	95-100	95-100	75-95	35-50	15-25
	26-60	Stratified silt loam to fine sand.	SC, SM, ML, CL	A-2, A-4, A-6	0	90-100	90-100	60-90	10-75	<35	NP-20
NsB, NsC2: Nichols	0-23	Very fine sandy loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-95	45-60	<20	2-6
	23-60	Stratified very fine sand to silt.	ML, CL-ML	A-4	0	100	95-100	85-100	75-100	<20	NP-6
OaB, OaC: Oakville	0-9	Loamy fine sand	SM	A-2	0	100	100	55-75	15-25	---	NP
	9-60	Fine sand	SM, SP, SP-SM	A-2, A-3	0	100	95-100	65-95	0-25	---	NP
OgB*:											
Oakville	0-9	Loamy fine sand	SM	A-2	0	100	100	55-75	15-25	---	NP
	9-60	Fine sand	SM, SP, SP-SM	A-2, A-3	0	100	95-100	65-95	0-25	---	NP
Granby	0-12	Fine sandy loam	SM	A-2	0	100	100	60-70	20-35	---	NP
	12-60	Sand	SP, SP-SM	A-3, A-2-4	0	100	95-100	50-70	0-5	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
OzC2: Omro	0-7	Loam	CL, CL-ML	A-4	0	95-100	95-100	85-100	65-90	20-30	5-10
	7-29	Clay, silty clay	CH	A-7	0-3	90-100	90-100	85-95	80-90	60-70	30-40
	29-60	Loam, gravelly sandy loam, fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4, A-2	0-10	65-90	65-90	45-85	30-65	<20	NP-7
Pa: Palms	0-36	Sapric material	Pt	---	---	---	---	---	---	---	---
	36-60	Stratified very fine sand to silt.	ML	A-4	0	100	100	80-100	40-95	<30	NP
Pe: Pella	0-10	Silt loam	CL	A-6, A-7	0	100	95-100	85-100	70-95	25-50	15-30
	10-36	Silty clay loam, silt loam.	CL	A-6. A-7	0	100	95-100	85-100	70-95	30-50	15-30
	36-60	Stratified silt loam to sandy loam.	CL	A-6, A-7	0-5	95-100	90-100	75-95	60-90	30-50	15-30
Pg*, Ph*. Pits											
PlB, PlC, PlD: Plainfield	0-13	Loamy sand	SM	A-2, A-4	0	100	100	55-95	15-40	---	NP
	13-60	Sand	SP	A-3	0	100	100	55-65	1-4	---	NP
Po: Poygan	0-10	Silty clay loam	CL, CH	A-7	0	100	100	90-100	75-95	45-55	25-35
	10-19	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	90-100	90-100	90-100	75-95	45-70	30-45
	19-60	Clay, silty clay	CL, CH	A-7, A-6	0-5	90-100	90-100	90-100	80-100	30-55	20-45
ShA: Shiocton	0-9	Very fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4	0	100	100	70-95	40-65	<30	NP-6
	9-21	Silt loam, very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-100	50-90	<30	NP-6
	21-60	Stratified silt loam to very fine sand.	ML, SM	A-4	0	100	100	80-100	40-95	<30	NP
SyA: Symco	0-8	Silt loam	ML, CL-ML, CL	A-4	0	100	100	85-100	60-90	20-30	3-10
	8-23	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-5	85-100	85-100	80-95	70-90	30-50	15-30
	23-60	Loam, clay loam, silty clay loam.	CL	A-6	0-5	85-100	85-100	80-90	70-85	25-40	11-20
TeA: Tedrow	0-7	Loamy fine sand	SM	A-2, A-4	0	100	95-100	60-80	20-40	---	NP
	7-25	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-4	0	100	95-100	60-80	20-40	---	NP
	25-60	Sand, fine sand	SM, SP	A-2, A-3	0	100	95-100	50-70	3-35	---	NP
ThB: Theresa	0-10	Silt loam	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	3-10
	10-18	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	18-34	Clay loam, loam	CL	A-6, A-7	0-2	80-100	80-100	70-95	60-90	35-50	15-30
	34-60	Loam, gravelly loam, gravelly sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-10	50-95	50-90	30-80	15-75	<20	NP-6

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
TuB----------------- Tustin	0-26	Loamy fine sand	SM	A-2	0	100	100	60-70	15-25	---	NP
	26-60	Silty clay, silty clay loam, clay.	CL, CH, ML	A-7	0	100	100	90-100	85-95	45-55	20-30
Ud*. Udorthents											
WaA----------------- Wasepi	0-11	Sandy loam------	SM, SM-SC	A-2, A-4	0-5	85-100	70-95	60-95	25-40	<27	NP-7
	11-18	Loamy sand, sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2, A-4, A-6	0-5	85-100	70-95	55-85	20-45	15-35	2-16
	18-60	Sand, gravel, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-10	40-80	35-70	30-60	0-10	---	NP
We------------------ Wauseon	0-10	Sandy loam------	SM, ML	A-2, A-4	0	100	95-100	70-85	25-55	<35	NP-8
	10-26	Fine sandy loam, loamy fine sand, very fine sand.	SM	A-2, A-4	0	100	95-100	65-95	20-45	---	NP
	26-60	Clay, silty clay, silty clay loam.	CH, CL, MH	A-7	0	100	95-100	90-100	80-95	42-70	18-36
WoB, WoC2, WoD2---- Waymor	0-13	Silt loam-------	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	3-10
	13-24	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	90-100	90-100	85-100	60-95	35-50	15-30
	24-35	Clay loam, loam	CL	A-6	0-10	70-100	70-100	70-95	60-80	25-40	10-25
	35-60	Loam, sandy loam	CL, ML, SM, SC	A-4, A-6, A-2	0-10	70-95	70-95	70-90	30-75	20-30	2-12
WpB----------------- Whalan	0-12	Silt loam-------	ML	A-4	0	100	95-100	85-95	60-90	30-40	5-10
	12-25	Silt loam, loam	CL	A-6	0	95-100	95-100	80-95	70-90	30-40	10-15
	25-32	Clay loam, clay, silty clay.	CL, CH, MH	A-7	0-2	90-100	80-95	80-90	60-75	40-60	20-30
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Wt------------------ Willette	0-28	Sapric material	Pt	---	---	---	---	---	---	---	---
	28-60	Silty clay------	CL, CH	A-7	0	100	95-100	90-100	85-95	45-60	25-34
WvB, WvC2---------- Wyocena Variant	0-11	Sandy loam------	SM	A-2	0	95-100	75-90	60-70	25-35	---	NP
	11-24	Sandy loam, loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0-5	95-100	75-90	60-75	25-60	<20	2-6
	24-60	Loamy sand------	SM	A-1, A-2	0-5	95-100	75-90	45-70	15-25	---	NP
ZuB, ZuC2---------- Zurich	0-7	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	80-95	25-40	5-20
	7-22	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	60-90	30-45	10-25
	22-60	Stratified silt loam to fine sandy loam.	ML, CL, SM, SC	A-2, A-4, A-6	0	90-100	80-100	70-100	30-70	20-40	NP-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH						
Ac------------------	0-40	0.2-6.0	0.35-0.45	5.1-7.8	----------	High-----	Moderate	0.10	5	3
Adrian	40-60	6.0-20	0.03-0.08	6.1-8.4	Low-------	High-----	Moderate	0.10		
As*. Aquents										
BcA-----------------	0-11	0.6-2.0	0.20-0.24	6.1-8.4	Low-------	Low------	Low------	0.32	5	5
Bellevue	11-35	0.6-2.0	0.12-0.19	6.1-8.4	Low-------	Low------	Low------	0.32		
	35-60	0.6-2.0	0.17-0.22	7.4-8.4	Low-------	Low------	Low------	0.32		
BrB, BrC2-----------	0-9	2.0-6.0	0.10-0.15	5.6-7.3	Low-------	Low------	Moderate	0.24	4-3	3
Boyer	9-29	2.0-6.0	0.12-0.18	5.6-7.8	Low-------	Low------	Moderate	0.24		
	29-60	>20	0.02-0.04	7.4-8.4	Low-------	Low------	Low------	0.10		
BsB-----------------	0-12	2.0-6.0	0.12-0.14	6.1-7.3	Low-------	Low------	Moderate	0.24	4	3
Boyer	12-29	2.0-6.0	0.10-0.15	6.1-7.8	Low-------	Low------	Moderate	0.24		
	29-48	>20	0.02-0.04	7.4-8.4	Low-------	Moderate	Low------	0.10		
	48-60	0.6-2.0	0.11-0.22	7.4-8.4	Low-------	Moderate	Low------	0.43		
BtB, BtC2-----------	0-10	0.6-2.0	0.20-0.24	6.1-7.3	Low-------	Moderate	Moderate	0.37	5-4	5
Briggsville	10-31	0.2-0.6	0.11-0.20	5.1-8.4	Moderate	High-----	Moderate	0.37		
	31-60	0.2-0.6	0.18-0.20	7.4-8.4	Moderate	High-----	Low------	0.37		
Bu------------------	0-12	0.6-2.0	0.21-0.24	6.6-7.3	Moderate	High-----	Low------	0.28	5	6
Brookston	12-19	0.6-2.0	0.15-0.19	6.6-7.3	Moderate	High-----	Low------	0.28		
	19-60	0.2-2.0	0.05-0.19	7.4-8.4	Moderate	High-----	Low------	0.28		
CnB, CnC------------	0-8	0.6-2.0	0.20-0.24	6.1-8.4	Low-------	Low------	Low------	0.37	2-1	6
Channahon	8-18	0.6-2.0	0.15-0.22	6.1-8.4	Moderate	Moderate	Low------	0.37		
	18-60	---	---	---	----------	---------	---------	---		
CoA-----------------	0-9	6.0-20	0.08-0.09	5.1-6.5	Very low	Moderate	Moderate	0.17	3	2
Cosad	9-26	6.0-20	0.05-0.07	5.1-7.3	Very low	Moderate	Moderate	0.17		
	26-60	<0.2	0.12-0.17	6.6-7.8	Moderate	High-----	Low------	0.28		
DoB-----------------	0-8	0.6-2.0	0.22-0.24	5.6-7.3	Low-------	Low------	Low------	0.37	4	5
Dodge	8-31	0.6-2.0	0.18-0.22	5.1-7.3	Moderate	Moderate	Moderate	0.37		
	31-37	0.6-2.0	0.16-0.19	5.1-7.3	Moderate	Moderate	Moderate	0.37		
	37-60	0.6-6.0	0.07-0.20	7.9-8.4	Low-------	Low------	Low------	0.37		
Du*. Dune land										
Fu*. Fluvaquents										
Gb------------------	0-12	6.0-20	0.16-0.18	5.6-7.3	Low-------	High-----	Low------	0.17	5	3
Granby	12-60	6.0-20	0.05-0.09	5.6-8.4	Low-------	High-----	Low------	0.17		
HmB, HmC2, HmD2----	0-11	0.6-2.0	0.20-0.24	6.1-7.8	Low-------	Low------	Low------	0.32	3	5
Hochheim	11-21	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	Moderate	Low------	0.32		
	21-60	0.2-2.0	0.08-0.17	7.9-8.4	Low-------	Moderate	Low------	0.32		
HnB*, HnC2*:										
Hochheim-----------	0-11	0.6-2.0	0.20-0.24	6.1-7.8	Low-------	Low------	Low------	0.32	3	5
	11-21	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	Moderate	Low------	0.32		
	21-60	0.2-2.0	0.08-0.17	7.9-8.4	Low-------	Moderate	Low------	0.32		
Nichols------------	0-23	0.6-2.0	0.15-0.22	6.1-7.8	Low-------	Low------	Low------	0.37	5-4	3
	23-60	0.6-2.0	0.10-0.14	7.9-8.4	Low-------	Low------	Low------	0.37		
Boyer--------------	0-9	2.0-6.0	0.10-0.15	5.6-7.3	Low-------	Low------	Moderate	0.24	4-3	3
	9-29	2.0-6.0	0.12-0.18	5.6-7.8	Low-------	Low------	Moderate	0.24		
	29-60	>20	0.02-0.04	7.4-8.4	Low-------	Low------	Low------	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea- bility	Available water capacity	Soil reaction	Shrink- swell potential	Risk of corrosion		Erosion factors		Wind erodi- bility group
						Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH						
HnD*:										
Hochheim----------	0-11	0.6-2.0	0.20-0.24	6.1-7.8	Low--------	Low------	Low------	0.32	3	5
	11-21	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	Moderate	Low------	0.32		
	21-60	0.2-2.0	0.08-0.17	7.9-8.4	Low--------	Moderate	Low------	0.32		
Boyer-------------	0-9	2.0-6.0	0.10-0.15	5.6-7.3	Low--------	Low------	Moderate	0.24	4-3	3
	9-29	2.0-6.0	0.12-0.18	5.6-7.8	Low--------	Low------	Moderate	0.24		
	29-60	>20	0.02-0.04	7.4-8.4	Low--------	Low------	Low------	0.10		
Nichols-----------	0-23	0.6-2.0	0.15-0.22	6.1-7.8	Low--------	Low------	Low------	0.37	5-4	3
	23-60	0.6-2.0	0.10-0.14	7.9-8.4	Low--------	Low------	Low------	0.37		
HrB, HrC2, HrD2---- Hortonville	0-7	0.6-2.0	0.20-0.24	5.1-7.3	Low--------	Low------	Moderate	0.37	5-4	5
	7-25	0.2-0.6	0.15-0.20	5.1-7.8	Moderate	Moderate	Moderate	0.37		
	25-60	0.2-0.6	0.15-0.20	7.9-8.4	Low--------	Moderate	Moderate	0.37		
Hu----------------- Houghton	0-60	2.0-6.0	0.35-0.45	6.6-7.3	-----------	High-----	Low------	0.10	5	3
Ke----------------- Keowns	0-13	0.6-6.0	0.13-0.22	6.6-8.4	Low--------	High-----	Low------	0.24	5	3
	13-29	0.6-2.0	0.12-0.22	6.6-8.4	Low--------	High-----	Low------	0.32		
	29-60	0.6-2.0	0.11-0.22	7.4-8.4	Low--------	High-----	Low------	0.32		
KnB, KnC2, KnD2, KnE--------------- Kewaunee	0-8	0.6-2.0	0.20-0.24	5.6-7.3	Low--------	Low------	Low------	0.37	3	5
	8-23	0.06-0.6	0.09-0.13	5.6-7.8	Moderate	Moderate	Low------	0.37		
	23-60	0.2-0.6	0.08-0.20	7.4-8.4	Moderate	Moderate	Low------	0.37		
KpB*, KpC2*, KpD*:										
Kewaunee----------	0-8	0.6-2.0	0.20-0.24	5.6-7.3	Low--------	Low------	Low------	0.37	3	5
	8-23	0.06-0.6	0.09-0.13	5.6-7.8	Moderate	Moderate	Low------	0.37		
	23-60	0.2-0.6	0.08-0.20	7.4-8.4	Moderate	Moderate	Low------	0.37		
Boyer-------------	0-9	2.0-6.0	0.10-0.15	5.6-7.3	Low--------	Low------	Moderate	0.24	4-3	3
	9-29	2.0-6.0	0.12-0.18	5.6-7.8	Low--------	Low------	Moderate	0.24		
	29-60	>20	0.02-0.04	7.4-8.4	Low--------	Low------	Low------	0.10		
Nichols-----------	0-23	0.6-2.0	0.15-0.22	6.1-7.8	Low--------	Low------	Low------	0.37	5-4	3
	23-60	0.6-2.0	0.10-0.14	7.9-8.4	Low--------	Low------	Low------	0.37		
KrB, KrC2---------- Kolberg	0-8	0.6-2.0	0.20-0.24	5.6-7.3	Low--------	Moderate	Moderate	0.43	3-2	5
	8-26	0.06-0.6	0.09-0.20	6.6-7.8	Moderate	Moderate	Low------	0.32		
	26-29	0.2-2.0	0.15-0.19	6.6-7.8	Moderate	Moderate	Low------	0.32		
	29-60	---	---	---	-----------	---------	---------	---		
LmA---------------- Lamartine	0-10	0.6-2.0	0.22-0.24	6.1-7.8	Low--------	High-----	Low------	0.32	5-4	5
	10-27	0.6-2.0	0.18-0.22	6.1-7.8	Moderate	High-----	Low------	0.43		
	27-32	0.6-2.0	0.15-0.19	6.6-7.8	Moderate	High-----	Low------	0.43		
	32-60	0.6-6.0	0.17-0.19	7.4-8.4	Low--------	High-----	Low------	0.32		
LuB, LuC2, LuD----- Lutzke	0-6	0.6-2.0	0.13-0.15	6.6-7.8	Low--------	Low------	Low------	0.24	3	3
	6-19	0.6-6.0	0.06-0.12	6.1-7.8	Low--------	Low------	Low------	0.24		
	19-24	0.6-6.0	0.03-0.09	6.6-7.8	Low--------	Low------	Low------	0.24		
	24-60	>20	0.01-0.02	7.4-8.4	Low--------	Low------	Low------	0.10		
MbA---------------- Manawa	0-7	0.6-2.0	0.20-0.24	6.1-7.8	Low--------	High-----	Low------	0.37	3	5
	7-22	0.06-0.2	0.09-0.20	6.1-8.4	Moderate	High-----	Low------	0.37		
	22-60	0.06-0.2	0.08-0.20	7.9-8.4	Moderate	High-----	Low------	0.37		
McB*:										
Manawa------------	0-7	0.6-2.0	0.20-0.24	6.1-7.8	Low--------	High-----	Low------	0.37	3	5
	7-22	0.06-0.2	0.09-0.20	6.1-8.4	Moderate	High-----	Low------	0.37		
	22-60	0.06-0.2	0.08-0.20	7.9-8.4	Moderate	High-----	Low------	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH						
McB*:										
Kewaunee----------	0-8	0.6-2.0	0.20-0.24	5.6-7.3	Low--------	Low------	Low------	0.37	3	5
	8-23	0.06-0.6	0.09-0.13	5.6-7.8	Moderate	Moderate	Low------	0.37		
	23-60	0.2-0.6	0.08-0.20	7.4-8.4	Moderate	Moderate	Low------	0.37		
Poygan------------	0-10	0.2-0.6	0.14-0.21	6.6-7.8	Moderate	High-----	Low------	0.37	3	7
	10-19	0.06-0.2	0.09-0.18	6.6-7.8	Moderate	High-----	Low------	0.37		
	19-60	0.06-0.2	0.08-0.12	7.4-7.8	Moderate	High-----	Low------	0.37		
MlA---------------- Mayville	0-8	0.6-2.0	0.22-0.24	5.6-7.3	Low--------	Moderate	Low------	0.37	4-3	5
	8-28	0.6-2.0	0.18-0.24	5.1-6.5	Moderate	Moderate	Moderate	0.37		
	28-34	0.6-2.0	0.15-0.20	5.1-6.5	Moderate	Moderate	Moderate	0.37		
	34-60	0.6-2.0	0.07-0.20	7.9-8.4	Low--------	Moderate	Low------	0.28		
MsA---------------- Mosel	0-12	0.6-2.0	0.20-0.24	5.6-7.8	Low--------	High-----	Low------	0.28	5	5
	12-24	0.6-2.0	0.12-0.19	5.6-7.8	Low--------	High-----	Low------	0.28		
	24-35	0.2-0.6	0.18-0.20	7.4-8.4	Moderate	High-----	Low------	0.28		
	35-60	0.2-0.6	0.18-0.20	7.4-8.4	Moderate	High-----	Low------	0.28		
MuA---------------- Mundelein	0-9	0.6-2.0	0.22-0.24	5.6-7.3	Low--------	High-----	Moderate	0.28	5	6
	9-26	0.2-2.0	0.18-0.20	5.6-7.3	Moderate	High-----	Moderate	0.43		
	26-60	0.2-2.0	0.05-0.22	6.1-8.4	Low--------	High-----	Low------	0.43		
NsB, NsC2---------- Nichols	0-23	0.6-2.0	0.15-0.22	6.1-7.8	Low--------	Low------	Low------	0.37	5-4	3
	23-60	0.6-2.0	0.10-0.14	7.9-8.4	Low--------	Low------	Low------	0.37		
OaB, OaC----------- Oakville	0-9	6.0-20	0.09-0.11	5.6-7.3	Low--------	Low------	Moderate	0.15	5	2
	9-60	6.0-20	0.06-0.08	5.6-7.3	Low--------	Low------	Moderate	0.15		
OgB*:										
Oakville----------	0-9	6.0-20	0.09-0.11	5.6-7.3	Low--------	Low------	Moderate	0.15	5	2
	9-60	6.0-20	0.06-0.08	5.6-7.3	Low--------	Low------	Moderate	0.15		
Granby------------	0-12	6.0-20	0.16-0.18	5.6-7.3	Low--------	High-----	Low------	0.17	5	3
	12-60	6.0-20	0.05-0.09	5.6-8.4	Low--------	High-----	Low------	0.17		
OzC2--------------- Omro	0-7	0.6-2.0	0.20-0.24	6.1-7.8	Low--------	Moderate	Low------	0.43	3	5
	7-29	0.06-0.6	0.09-0.13	6.1-7.8	Moderate	High-----	Low------	0.32		
	29-60	0.6-2.0	0.08-0.19	7.9-8.4	Low--------	High-----	Low------	0.32		
Pa----------------- Palms	0-36	2.0-6.0	0.35-0.45	5.1-8.4	-----------	High-----	Moderate	0.10	5	3
	36-60	0.2-0.6	0.14-0.16	6.6-8.4	Low--------	High-----	Low------	0.43		
Pe----------------- Pella	0-10	0.6-2.0	0.22-0.24	6.1-7.8	Moderate	High-----	Low------	0.28	5	6
	10-36	0.6-2.0	0.21-0.24	7.4-8.4	Moderate	High-----	Low------	0.28		
	36-60	0.6-2.0	0.15-0.20	7.4-8.4	Moderate	High-----	Low------	0.28		
Pg*, Ph*. Pits										
PlB, PlC, PlD------ Plainfield	0-13	2.0-6.0	0.10-0.13	4.5-6.0	Low--------	Low------	High-----	0.17	5	2
	13-60	6.0-20	0.05-0.07	4.5-7.3	Low--------	Low------	High-----	0.17		
Po----------------- Poygan	0-10	0.2-0.6	0.14-0.21	6.6-7.8	Moderate	High-----	Low------	0.37	3	7
	10-19	0.06-0.2	0.09-0.18	6.6-7.8	Moderate	High-----	Low------	0.37		
	19-60	0.06-0.2	0.08-0.12	7.4-7.8	Moderate	High-----	Low------	0.37		
ShA---------------- Shiocton	0-9	0.6-2.0	0.16-0.22	6.1-7.8	Low--------	Moderate	Low------	0.20	5	3
	9-21	0.6-2.0	0.17-0.22	6.6-8.4	Low--------	Moderate	Low------	0.43		
	21-60	0.6-2.0	0.14-0.16	6.6-8.4	Low--------	Moderate	Low------	0.43		
SyA---------------- Symco	0-8	0.6-2.0	0.22-0.24	7.4-8.4	Low--------	High-----	Low------	0.32	5-4	6
	8-23	0.2-0.6	0.15-0.17	7.4-8.4	Moderate	High-----	Low------	0.32		
	23-60	0.2-0.6	0.16-0.18	7.4-8.4	Low--------	High-----	Low------	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH						
TeA----------------- Tedrow	0-7	6.0-20	0.08-0.12	6.1-7.3	Low--------	Low------	Low------	0.17	5	2
	7-25	6.0-20	0.07-0.11	6.1-7.3	Low--------	Low------	Low------	0.17		
	25-60	6.0-20	0.05-0.07	6.6-7.8	Low--------	Low------	Low------	0.17		
ThB----------------- Theresa	0-10	0.6-2.0	0.22-0.24	6.1-7.8	Low--------	Low------	Low------	0.32	4	5
	10-18	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	Moderate	Low------	0.43		
	18-34	0.6-2.0	0.15-0.19	6.6-8.4	Moderate	Moderate	Low------	0.43		
	34-60	0.6-2.0	0.08-0.17	7.9-8.4	Low--------	Moderate	Low------	0.43		
TuB----------------- Tustin	0-26	2.0-6.0	0.10-0.12	5.6-7.3	Low--------	Low------	Moderate	0.17	4	2
	26-60	0.06-0.2	0.10-0.16	6.1-8.4	Moderate	High-----	Low------	0.32		
Ud*. Udorthents										
WaA----------------- Wasepi	0-11	2.0-6.0	0.13-0.15	5.6-7.3	Low--------	Moderate	Moderate	0.20	4	3
	11-18	2.0-6.0	0.12-0.18	5.6-7.3	Low--------	Moderate	Moderate	0.20		
	18-60	>20.0	0.02-0.04	7.4-7.8	Low--------	Moderate	Low------	0.10		
We------------------ Wauseon	0-10	2.0-6.0	0.12-0.18	6.1-7.3	Low--------	High-----	Low------	0.20	5	3
	10-26	6.0-20	0.06-0.10	6.6-7.8	Low--------	High-----	Low------	0.20		
	26-60	<0.06	0.06-0.10	7.4-7.8	High-------	High-----	Low------	0.20		
WoB, WoC2, WoD2---- Waymor	0-13	0.6-2.0	0.22-0.24	6.1-7.8	Low--------	Moderate	Low------	0.32	5-4	5
	13-24	0.6-2.0	0.15-0.20	6.1-7.8	Moderate	Moderate	Low------	0.32		
	24-35	0.6-2.0	0.15-0.19	6.1-7.8	Moderate	Moderate	Low------	0.32		
	35-60	0.6-2.0	0.14-0.19	7.9-8.4	Low--------	Moderate	Low------	0.32		
WpB----------------- Whalan	0-12	0.6-2.0	0.22-0.24	5.6-7.3	Low--------	Moderate	Low------	0.32	4-3	6
	12-25	0.6-2.0	0.17-0.19	5.1-7.3	Moderate	Moderate	Low------	0.32		
	25-32	0.2-0.6	0.15-0.19	5.1-7.8	High-------	High-----	Moderate	0.32		
	32-60	---	---	---	-----------	---------	---------	---		
Wt------------------ Willette	0-28	2.0-6.0	0.35-0.45	6.1-7.8	-----------	High-----	Low------	---	---	3
	28-60	<0.06	0.12-0.16	7.4-8.4	High-------	High-----	Low------	---		
WvB, WvC2---------- Wyocena Variant	0-11	2.0-6.0	0.13-0.15	6.6-7.3	Low--------	Low------	Low------	0.24	5	3
	11-24	2.0-6.0	0.12-0.17	6.6-7.3	Low--------	Low------	Low------	0.24		
	24-60	2.0-6.0	0.06-0.08	7.4-7.8	Low--------	Low------	Low------	0.17		
ZuB, ZuC2---------- Zurich	0-7	0.6-2.0	0.22-0.24	6.1-7.3	Low--------	Moderate	Low------	0.37	5-4	6
	7-22	0.6-2.0	0.18-0.22	4.5-7.8	Moderate	Moderate	Moderate	0.37		
	22-60	0.6-6.0	0.14-0.22	7.4-8.4	Low--------	Moderate	Low------	0.37		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Subsidence	Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Total	
					Ft			In		In	
Ac----------------- Adrian	A/D	Frequent----	Long------	Nov-May	0-1.0	Apparent	Nov-May	>60	---	25-32	High.
As*. Aquents											
BcA--------------- Bellevue	B	Frequent----	Brief-----	Sep-May	3.0-6.0	Apparent	Sep-May	>60	---	---	Moderate.
BrB, BrC2, BsB---- Boyer	B	None--------	---	---	>6.0	---	---	>60	---	---	Low.
BtB, BtC2--------- Briggsville	C	None--------	---	---	>3.0	Apparent	Mar-May	>60	---	---	High.
Bu----------------- Brookston	B/D	Frequent----	Brief-----	Dec-May	0-1.0	Apparent	Dec-May	>60	---	---	High.
CnB, CnC---------- Channahon	D	None--------	---	---	>6.0	---	---	10-20	Hard	---	Moderate.
CoA--------------- Cosad	C	None--------	---	---	1.0-3.0	Perched	Dec-May	>60	---	---	Moderate.
DoB--------------- Dodge	B	None--------	---	---	>6.0	---	---	>60	---	---	High.
Du*. Dune land											
Fu*. Fluvaquents											
Gb----------------- Granby	A/D	Frequent----	Brief-----	Mar-Apr	0-1.0	Apparent	Nov-Jun	>60	---	---	Moderate.
HmB, HmC2, HmD2--- Hochheim	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate.
HnB*, HnC2*: Hochheim----------	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate.
Nichols-----------	B	None--------	---	---	>6.0	---	---	>60	---	---	High.
Boyer-------------	B	None--------	---	---	>6.0	---	---	>60	---	---	Low.
HnD*: Hochheim----------	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate.
Boyer-------------	B	None--------	---	---	>6.0	---	---	>60	---	---	Low.
Nichols-----------	B	None--------	---	---	>6.0	---	---	>60	---	---	High.
HrB, HrC2, HrD2--- Hortonville	B	None--------	---	---	>6.0	---	---	>60	---	---	Moderate.
Hu----------------- Houghton	A/D	Frequent----	Long------	Nov-May	0-1.0	Apparent	Sep-Jun	>60	---	55-60	High.
Ke----------------- Keowns	B/D	Frequent----	Brief-----	Mar-Apr	0-1.0	Apparent	Oct-May	>60	---	---	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Subsidence	Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Total	
					Ft			In		In	
KnB, KnC2, KnD2, KnE: Kewaunee	C	None	---	---	>6.0	---	---	>60	---	---	Moderate.
KpB*, KpC2*, KpD*:											
Kewaunee	C	None	---	---	>6.0	---	---	>60	---	---	Moderate.
Boyer	B	None	---	---	>6.0	---	---	>60	---	---	Low.
Nichols	B	None	---	---	>6.0	---	---	>60	---	---	High.
KrB, KrC2: Kolberg	C	None	---	---	>6.0	---	---	20-40	Rippable	---	Moderate.
LmA: Lamartine	B	Occasional	Very brief	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	---	High.
LuB, LuC2, LuD: Lutzke	B	None	---	---	>6.0	---	---	>60	---	---	Low.
MbA: Manawa	C	Occasional	Brief	Nov-May	1.0-3.0	Perched	Nov-Jun	>60	---	---	High.
McB*:											
Manawa	C	Occasional	Brief	Nov-May	1.0-3.0	Perched	Nov-Jun	>60	---	---	High.
Kewaunee	C	None	---	---	>6.0	---	---	>60	---	---	Moderate.
Poygan	D	Frequent	Long	Nov-Jun	0-1.0	Perched	Nov-Jul	>60	---	---	High.
MlA: Mayville	B	None	---	---	3.0-5.0	Apparent	Nov-Apr	>60	---	---	High.
MsA: Mosel	C	Rare	---	---	1.0-3.0	Perched	Nov-May	>60	---	---	High.
MuA: Mundelein	B	None	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	---	High.
NsB, NsC2: Nichols	B	None	---	---	>6.0	---	---	>60	---	---	High.
OaB, OaC: Oakville	A	None	---	---	>6.0	---	---	>60	---	---	Low.
OgB*:											
Oakville	A	None	---	---	>6.0	Apparent	Nov-Apr	>60	---	---	Low.
Granby	A/D	Frequent	Brief	Mar-Apr	0-1.0	Apparent	Nov-Jun	>60	---	---	Moderate.
OzC2: Omro	C	None	---	---	>6.0	---	---	>60	---	---	Moderate.
Pa: Palms	A/D	Frequent	Long	Nov-May	0-1.0	Apparent	Nov-May	>60	---	25-32	High.
Pe: Pella	B/D	Occasional	Brief	Mar-Jun	0-1.0	Apparent	Mar-Jun	>60	---	---	High.
Pg*, Ph*. Pits											
PlB, PlC, PlD: Plainfield	A	None	---	---	>6.0	---	---	>60	---	---	Low.
Po: Poygan	D	Frequent	Long	Nov-Jun	0-1.0	Perched	Nov-Jul	>60	---	---	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Subsidence	Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Total	
					Ft			In		In	
ShA: Shiocton	B	Occasional	Brief	Mar-May	1.0-3.0	Apparent	Sep-Jul	>60	---	---	High.
SyA: Symco	B	Rare	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High.
TeA: Tedrow	B	None	---	---	1.0-3.0	Apparent	Jan-Apr	>60	---	---	Moderate.
ThB: Theresa	B	None	---	---	>6.0	---	---	>60	---	---	Moderate.
TuB: Tustin	B	None	---	---	>6.0	---	---	>60	---	---	Moderate.
Ud*. Udorthents											
WaA: Wasepi	B	Rare	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High.
We: Wauseon	B/D	None	---	---	0-1.0	Perched	Jan-Apr	>60	---	---	High.
WoB, WoC2, WoD2: Waymor	B	None	---	---	>6.0	---	---	>60	---	---	Moderate.
WpB: Whalan	B	None	---	---	>6.0	---	---	20-40	Rippable	---	Moderate.
Wt: Willette	A/D	Frequent	Long	Nov-May	0-1.0	Perched	Nov-May	>60	---	---	High.
WvB, WvC2: Wyocena Variant	B	None	---	---	>6.0	---	---	>60	---	---	Moderate.
ZuB, ZuC2: Zurich	B	None	---	---	>6.0	---	---	>60	---	---	High.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING TEST DATA

[Tests performed by Wisconsin Department of Transportation, Division of Highways. Absence of an entry indicates that no determination was made]

Soil name and location	Parent material	Sample number	Depth	Moisture density: Maximum dry density	Moisture density: Optimum moisture	Percentage passing sieve--[1] No. 4	No. 10	No. 40	No. 200	Percentage smaller than--[1] 0.05 mm	0.02 mm	0.005 mm	0.002 mm	Liquid limit	Plasticity index	Classification: AASHTO	Classification: Unified
			In	Lb/cu ft	Pct									Pct			
Briggsville silt loam:[2] SW1/4NE1/4 sec. 18, T. 19 N., R. 24 E. (Modal profile)	Lacustrine sediments.	S72-WI-36-1-1	16-21	---	---	---	---	---	98	98	89	66	48	52.6	29.5	A-7-6	CH
		S72-WI-36-1-2	31-60	105.7	19.3	---	---	---	99	99	98	69	33	39.0	18.2	A-6	CL
Briggsville silt loam:[2] SE1/4SW1/4 sec. 17, T. 20 N., R. 24 E. (Modal profile)	Lacustrine sediments.	S72-WI-36-4-1	8-16	---	---	---	---	100	96	94	78	57	45	42.8	23.2	A-7-6	CL
		S72-WI-36-4-2	25-60	104.7	18.2	---	---	100	98	98	91	66	47	49.2	29.0	A-7-6	CL
Hochheim loam:[2] NW1/4NE1/4 sec. 8, T. 17 N., R. 20 E. (Modal profile)	Glacial till--	S72-WI-8-1-1	7-18	---	---	97	96	90	69	65	53	35	28	35.5	18.3	A-6	CL
			21-60	139.0	6.9	78	73	66	41	36	22	9	6	13.0	NP[3]	A-4	SM
Kewaunee loam: NW1/4NW1/4 sec. 24, T. 20 N., R. 24 E. (Modal profile)	Glacial till--	S72-WI-36-2-1	12-18	---	---	---	100	96	75	72	66	55	47	49.6	30.0	A-7-6	CL
		S72-WI-36-2-2	23-60	113.6	16.6	---	100	97	86	82	70	54	40	37.6	21.8	A-6	CL
Mosel loam: NE1/4SE1/4 sec. 4, T. 20 N., R. 20 E. (Modal profile)	Outwash over lacustrine sediments.	S72-WI-8-2-1	12-17	---	---	---	100	92	48	45	38	24	18	22.4	8.9	A-4	SC
		S72-WI-8-2-2	35-60	---	---	---	100	98	85	80	74	55	38	41.8	24.9	A-7-6	CL
Pella silt loam: NE1/4NW1/4 sec. 16, T. 17 N., R. 20 E. (Modal profile)	Loess over glacial till.	S74-WI-8-1-1	22-30	---	---	---	100	99	96	90	63	27	19	32.2	12.0	A-6	CL
		S74-WI-8-1-2	36-60	---	---	98	97	94	88	84	58	25	17	29.2	8.8	A-4	CL

Shiocton very fine sandy loam:[2] NW1/4SW1/4 sec. 2, T. 20 N., R. 20 E. (Modal profile)	Lacustrine sediments.	S72-WI-8-3-1	9-14	---	---	---	---	---	71	54	26	13	8	---	NP	A-4	ML
		S72-WI-8-3-2	19-60	---	---	---	---	100	40	30	17	8	4	---	NP	A-4	SM

1 Results obtained by this procedure may differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method, and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soil.

2 These soils are taxadjuncts. See the series descriptions for an explanation.

3 NP means nonplastic.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists
Aquents	Loamy and clayey Aquents
Bellevue	Fine-loamy, mixed, mesic Fluventic Hapludolls
Boyer	Coarse-loamy, mixed, mesic Typic Hapludalfs
*Briggsville	Fine, mixed, mesic Typic Hapludalfs
*Brookston	Fine-loamy, mixed, mesic Typic Argiaquolls
Channahon	Loamy, mixed, mesic Lithic Argiudolls
*Cosad	Sandy over clayey, mixed, nonacid, mesic Aquic Udorthents
*Dodge	Fine-silty, mixed, mesic Typic Hapludalfs
Fluvaquents	Loamy and sandy, mixed, nonacid, mesic Typic Fluvaquents
Granby	Sandy, mixed, mesic Typic Haplaquolls
*Hochheim	Fine-loamy, mixed, mesic Typic Argiudolls
Hortonville	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
Houghton	Euic, mesic Typic Medisaprists
*Keowns	Coarse-loamy, mixed, nonacid, mesic Mollic Haplaquepts
Kewaunee	Fine, mixed, mesic Typic Hapludalfs
*Kolberg	Fine, mixed Glossic Eutroboralfs
Lamartine	Fine-silty, mixed, mesic Aquollic Hapludalfs
Lutzke	Loamy-skeletal, mixed, mesic Typic Hapludalfs
Manawa	Fine, mixed, mesic Aquollic Hapludalfs
*Mayville	Fine-silty, mixed, mesic Typic Hapludalfs
Mosel	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Mundelein	Fine-silty, mixed, mesic Aquic Argiudolls
*Nichols	Coarse-silty, mixed, frigid Typic Eutrochrepts
Oakville	Mixed, mesic Typic Udipsamments
Omro	Clayey over loamy, mixed, mesic Typic Hapludalfs
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Pella	Fine-silty, mixed, mesic Typic Haplaquolls
Plainfield	Mixed, mesic Typic Udipsamments
Poygan	Fine, mixed, mesic Typic Haplaquolls
*Shiocton	Coarse-silty, mixed Aquic Haploborolls
Symco	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Tedrow	Mixed, mesic Aquic Udipsamments
Theresa	Fine-loamy, mixed, mesic Typic Hapludalfs
Tustin	Clayey, mixed, mesic Arenic Hapludalfs
Udorthents	Loamy and clayey, mixed, mesic Udorthents
*Wasepi	Coarse-loamy, mixed, mesic Aquollic Hapludalfs
Wauseon	Coarse-loamy over clayey, mixed, mesic Typic Haplaquolls
Waymor	Fine-loamy, mixed, mesic Haplic Glossudalfs
Whalan	Fine-loamy, mixed, mesic Typic Hapludalfs
Willette	Clayey, illitic, euic, mesic Terric Medisaprists
Wyocena Variant	Coarse-loamy, mixed, mesic Glossoboric Hapludalfs
Zurich	Fine-silty, mixed, mesic Typic Hapludalfs

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